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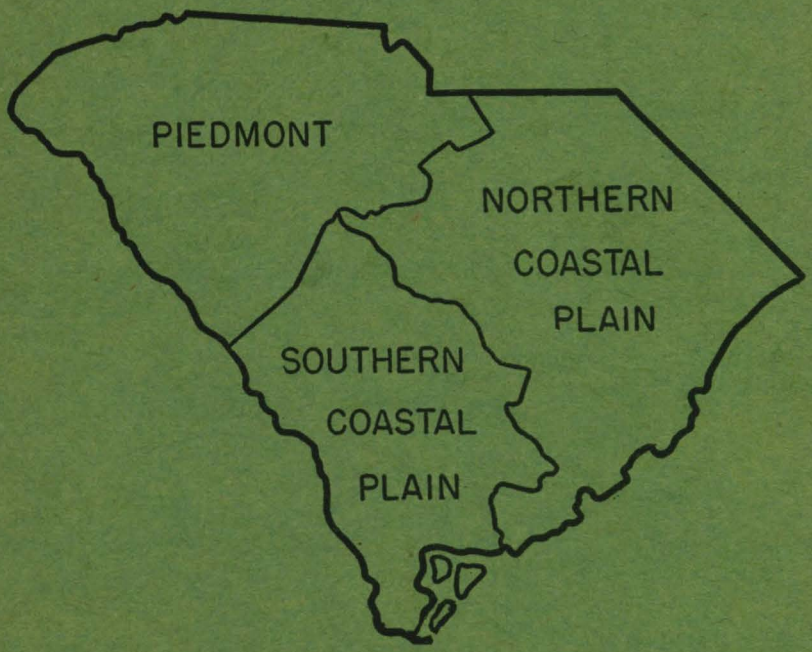
THE TIMBER SUPPLY OUTLOOK in SOUTH CAROLINA



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Forest Resource Report No. 3

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The Timber Supply Outlook In South Carolina

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Preface

CONGRESS, by the McSweeney-McNary Forest Research Act of May 22, 1928, authorized the Secretary of Agriculture to make and keep current a survey of the Nation's forest resources. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act. In the Southeastern States the Forest Survey is an activity of the Division of Forest Economics of the Southeastern Forest Experiment Station, Asheville, N. C.

The five-fold purpose of the survey is: (1) To determine the extent, location, and condition of forest lands, and species, quantity, and quality of timber on these lands; (2) to ascertain the current and probable future productivity of forest stands; (3) to determine the quantity of timber cut for industrial and domestic uses, and the losses from fire, insects, disease, suppression, and other causes; (4) to ascertain the present and probable future trend in requirements for forest products by all classes of consumers; and (5) to interpret these findings and correlate them with other economic factors as a basis for formulating public and private policies for effective and rational use and management of land suitable for forest production.

Results of the Forest Survey are published in a series of reports that supply information needed for planning a long-time program for timber production and some detailed information of use in guiding forest industry development. In this report no attempt is made to fully evaluate the use of forests for watershed protection, wildlife, recreation, or grazing even though such services of the forest are of considerable importance in South Carolina.

South Carolina was first inventoried by the Forest Survey in the period 1934-36, and the results were published in United States Department of Agriculture Miscellaneous Publication No. 552, South Carolina Forest Resources and Industries. Since then better forest management, changes in land use, and much heavier industrial use of timber have caused marked changes in the forest growing stock. The information presented here is based upon a resurvey of the State, made between November 1946 and March 1948. It furnishes the background for an understanding of the present forest conditions in South Carolina and focuses attention upon the principal forest problems and possible solutions

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Summary of Survey Findings

FORESTS are among South Carolina's most valuable assets. All together, forested land of South Carolina adds up to 62 percent of the total land area. The annual harvest of timber provides the raw material for a group of manufacturing industries ranking second only to textiles in value of products. These forest industries provide 35,000 jobs and furnish the major means of livelihood to at least 100,000 people.

Timber Supply Shrinking

Between 1936 and 1947 the total volume of sound trees 5.0 inches and larger decreased by 5 percent. Saw timber declined by 10 percent. Pine, which took the brunt of the reductions in board-foot volume, decreased by 12 percent; hardwood volume dropped. only 6 percent. Overcutting was particularly severe in the southern Coastal Plain; here pine saw timber declined by 29 percent and hardwood by 16 percent.

Pole timber, both pine and hardwoods, was also heavily overcut in the southern Coastal Plain. These losses, however, were more than offset during the period by a large increase in pole timber in the Piedmont.

Timber Demands Growing

The decline in timber volumes is mainly the result of a growing demand for timber by local forest industries. The completion of two large pulp and paper mills in 1937 and their subsequent expansion increased the total pulping capacity in the State from 100 tons per 24 hours in 1936 to over 2,000 tons in 1949. Thus, pulpwood drain has increased from only 49,000 cords in 1936 to nearly 1 million cords in 1946, and in this latter year amounted to 20 percent of the total drain. The lumber industry has also expanded. Since 1936, the number of active sawmills in the State has doubled; consequently, sawlogs for lumber production still account for nearly one-half the total drain and two-thirds of the saw-timber drain. Also, the number of veneer plants has nearly doubled and miscellaneous small plants such as handle plants, stave mills, and shingle mills have increased in number from 34 in 1936 to 81 in 1946. These expansions in the forest industries have added 300 million board feet to the saw-timber drain, or a million cords to the total drain. The total drain was 25 percent more in 1946 than in 1936.

Serious Overcutting of Best Timber Continues

A comparison of growth and drain in 1946 disclosed a continuation of overcutting which accelerated sharply in 1940 and continued in succeeding years. The best timber — softwood and soft hardwood — was still being overcut. For the State as a whole, softwood saw-timber drain exceeded growth by 15 percent and soft hardwood drain exceeded growth by 3 percent. Softwood saw timber in the southern Coastal Plain was being cut 35 percent faster than it was being grown, and in the Piedmont 27 percent faster. Soft hardwoods (gums, soft maple, and yellow-poplar) were faring only slightly better than the softwoods in these areas.

Overcutting of the pole timber had increased; in 1946, all pole timber in the Coastal Plain was seriously overcut. The heaviest drain on the softwoods came from pulpwood cutting. Heavy fuel-wood cutting, especially in the tobacco-growing counties of the northern Coastal Plain, made deep inroads into the harwood pole-timber growing stock. While pole timber was still increasing in the Piedmont, the surplus growth in 1946 was not enough to offset 1946 overcutting in the Coastal Plain.

No Easing of the Drain Pressure in Sight

The amount and kind of timber cut (commodity drain) is closely related to economic conditions. On the other hand, with falling prices the drain on the marginal timber eases, but remains relatively high on the better trees and stands. Thus, past experience shows that drain on the most valuable timber remains heavy in either case. A sufficient rise in prices generally starts hundreds of shut-down small sawmills to producing, and sends commodity drain to high levels.

In spite of possible periodic setbacks in economic activity, a growing population and a rising national income will very likely hold the average drain at or

above the postwar level. Thus, unless adjustments are made in the present drain pattern, further reductions in growing stock will probably take place, especially in the softwood saw-timber volume in the Piedmont and southern Coastal Plain, and in all pole timber throughout the Coastal Plain.

Forest Growth Far Short of Potential

South Carolina has plenty of forest land to grow the timber it needs. In 1947, the area of commercial forest land was 11.9 million acres, 11 percent more than in 1936. The greatest increase occurred in the Piedmont, where a large amount of former agricultural land has reverted to forest.

Under reasonably good forest management, this 11.9 million acres could easily grow half again as much timber 5.0 inches and larger, and nearly twice as much saw timber as at present. The Forest Survey reveals some of the reasons why productivity is so low. Four and a half million acres, or 40 percent of the total forest area, is less than 40 percent stocked; 14 percent is under 10 percent stocked.

A shortage of certain sizes of timber also contributes to low productivity. Saw timber is deficient throughout the State, but is especially so in the Piedmont. The Coastal Plain has a slightly better supply of saw timber, but shows a marked deficiency of both hardwood and softwood pole timber. In saplings, there is a deficiency of softwoods and a surplus of hardwoods.

About three-fifths of the timber South Carolina uses is pine. The ability of the forests to meet the demand for pine is seriously threatened by the steady decline in the proportion of pine in the State. Since 1936, the area of hardwood types has increased considerably, while the area of pine types has decreased. At the same time, hardwood volumes have decreased less than pine.

Improving the productivity of the stands is made especially difficult by the high proportion of cull trees, mainly hardwoods, in the stands. A fifth of the live trees in the State are culls. Cull-tree volume, mainly hardwoods, now makes up 20 percent of the total cubic-foot volume, compared to 11 percent in 1936. Also reflecting a general down-grading in quality of timber, the average volume per saw-timber tree has declined from 123 board feet in 1936 to 105 board feet in 1947, a reduction of 15 percent. As the best stands are cut and the best trees in the stand are removed, the proportion of short-boled, poor-form, and highly defective trees continues to rise.

Timber Growth Should Be Increased

To meet current needs, plus a margin for normal industrial expansion and unforeseen demands upon the forest, South Carolina should plan a 23-percent increase in total growth of all sound trees 5.0 inches d.b.h. and larger. This would approximate South Carolina's share of the national growth goal as estimated by the U. S. Forest Service (*15*).[1] It is estimated that South Carolina should plan to grow 1,865 million board feet, compared with current growth of 1,457 million board feet. Softwood growth should be increased by 40 percent, while a 6-percent increase in hardwoods would be sufficient to meet growth goals. Increases in hardwood growth should be confined to the gums, soft maples, and yellow-poplar, where the gap between growth and drain is almost as great as that in the softwoods.

No increase in pole-timber growth is needed in the Piedmont. However, substantial increases are necessary in the Coastal Plain in order to provide enough pole trees to maintain the saw-timber growing stock required for achieving the saw-timber growth goals.

The Way Out

The measures needed to increase the timber yield in South Carolina include changes in the amount of timber cut by species, size, and locality, planning for and guiding the development of forest industries, better timber-growing practices, and a stepped-up planting program.

Adjust Pattern of Timber Harvesting

As long as the demand for timber continues at the 1946 level, it will not always be possible to eliminate overcutting completely by making shifts in commodity drain. However, without exception, further damages to the growing stock can be reduced. For example, overcutting of the softwood saw timber in the southern Coastal Plain could be eased by shifting some of this drain to the northern Coastal Plain, where cutting is not nearly so heavy. Also, local markets for rough hardwood lumber in the Coastal Plain would permit some of the small sawmills to shift to cutting oak instead of pine.

Also, further overcutting of the already short supply of pine pole timber throughout the Coastal Plain can be largely eliminated by making a greater use of tops and thinnings for pulpwood, and by shifting some of the pulpwood cutting to the pole timber in the Piedmont.

[1] Italic numbers in parentheses refer to Literature Cited, p. 58.

This shift is especially desirable in view of the need for an adequate supply of pole timber to maintain and build up the saw-timber growing stock.

While overcutting of saw timber in the Piedmont is especially serious in view of the present low supply, the surplus of pole timber here offers an excellent opportunity to ease the drain on saw timber. The pulpwood drain on at least the larger saw-timber trees should be shifted to the pole timber. Cutting the small 9- and 10-inch trees into pulpwood instead of sawlogs would result in a saving through better utilization. Not only do these small trees yield mainly low-grade lumber, but an especially large part of the total cubic volume goes into sawdust and slabs.

Throughout the State a saving could also be made by using less pine and more low-quality hardwoods and sawmill wastes for fuel wood.

Guide Development of Forest Industries

Until growth balances drain, it will be desirable to discourage expansion of any forest industries that would increase the drain pressure on pine or soft hardwood. New industries should be directed toward the use of the oaks and hickories, the tremendous volume of cull hardwoods, and manufacturing wastes, such as shavings and sawdust. For instance, the establishment of plants that would manufacture short-length, packaged oak lumber would make it possible for small mills to cut oak instead of pine. The manufacture of molasses from hardwoods would provide a market for the growing amount of low-grade material in the stand. Further refinement of lumber and veneer now exported from the State would permit an expansion in the wood-using industry without putting more drain on the timber supply.

Improve Timber-Growing Practices

Building up the growing stock will take more than adjustments in the drain pattern and guiding forest industrial development. Easing the drain on timber overcut and in short supply may serve to stop further deterioration, but this will not improve the stocking and quality of forest stands. To do this, additional measures are necessary.

First of all, the area burned by uncontrolled fires should be reduced to a practical minimum in order to eliminate the annual destruction of large numbers of seedlings and saplings. During recent years great progress has been made in protecting South Carolina's forests from fire. Organized fire control has been extended from 2.5 million acres in 1936 to the entire area of 11.9 million acres of forest lands in the State. More intensive protection can further reduce timber losses.

Special steps should be taken to assure natural regeneration of desirable species, and established stands should be improved through cultural measures such as thinning and removing the undesirable trees. The area of forest lands under fair to high standards of management has been steadily expanded, particularly on the part of pulp companies and the larger wood-using firms. There is much room for improvement of management practices, however, particularly on the part of the small owners.

In many instances further study of the best timber-growing methods is needed. Guides for classifying pine and hardwood sites should be developed to prevent costly and unsuccessful attempts to grow pine on sites better suited to growing hardwoods. The economics and silviculture of growing timber on each of the principal kinds of forest land should be worked out to permit landowners to make the best use of their timberland and thereby realize the greatest returns on their investment. Also, efficient ways of curbing hardwoods to permit reliable and cheap control of species composition need further study.

Plant Idle and Poorly Stocked Land

Natural regeneration should be supplemented by planting about 1,349,000 acres to pine in the next 20 years in order to build up the necessary backlog of young pine timber. Most of the planting should be concentrated in the Coastal Plain, including the Sandhills, where young pine is not only in short supply but is increasing very slowly. For the most part, natural regeneration is adequate in the Piedmont, but planting is desirable on some areas to prevent further deterioration of the site, or to assure prompt restocking with more desirable species.

Tree planting in Sorth Carolina has shown a marked upward trend in recent years. Currently production of forest tree nursery stock is about 32 million trees annually or sufficient to plant approximately 36,000 acres. However, accomplishing the job in 20 years would mean planting 67,000 acres annually, almost twice the area that is now being planted.

South Carolina's Stake in Her Forests

FORESTS grow on 3 out of every 5 acres of land in South Carolina. They range from high-quality loblolly pine and bottom-land hardwood stands to low-quality Virginia pine and scrub oak stands, from extensive unbroken wooded areas on the Coastal Plain to small patches of woodlands which dot the landscape of the more intensively farmed Piedmont. All together, forested land adds up to 62 percent of the total land area, putting South Carolina high on the list of important timber-producing States in the Southeast (fig. 1). South Carolina leads the five Southeastern States in pulpwood production per acre of commercial forest land and is second only to North Carolina in lumber production per forested acre.

About 1.5 billion board feet of saw-timber harvested annually for these and other forest products provide the raw materials for a manufacturing industry ranking second only to textiles in value of product. In addition, forest cover on eroded and abandoned land plays an important part in safeguarding water supplies needed by hydroelectric installations and industrial plants. Hunting, fishing, picnicking, and other forms of outdoor recreation attract several million persons to the forests each year. In 1948, the State Forests and Parks alone received more than 1.5 million visitors.

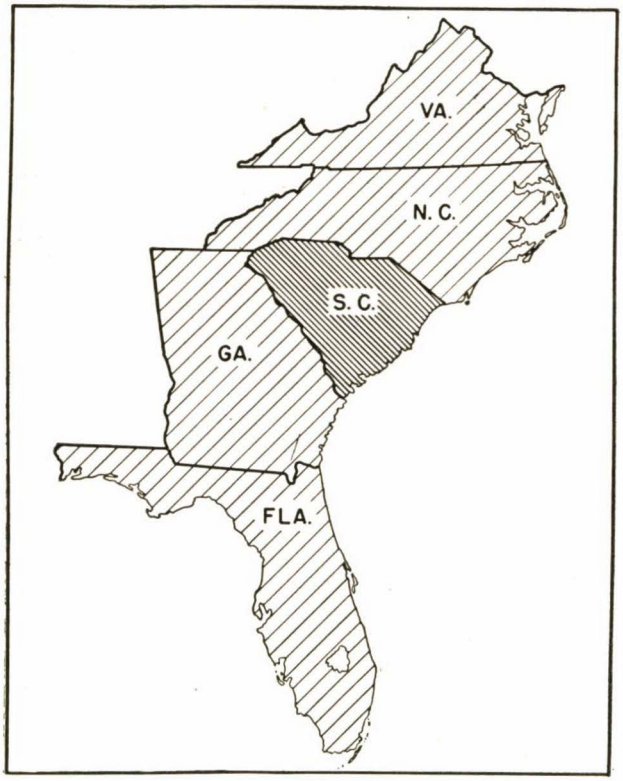

FIGURE 1. — *South Carolina and other southeastern States.*

FORESTS VITAL TO RURAL SECTIONS

No section of the State has a greater stake in timber resources than the rural areas — and South Carolina is predominantly rural. Farmers, woods workers, sawmill workers, and local merchants depend on the forests for supplemental income or sole means of obtaining a livelihood (fig. 2).

As a crop from the State's land resources, primary forest products rank second only to cotton in value (7). The values of the four leading crops in 1947 were as follows:

Four leading crops:	*Value, 1947 (million dollars)*
Cotton and cottonseed	126
Primary forest products	72
Tobacco	65
Corn	55

These primary forest products represent an array of commodities. Sawlogs, pulpwood bolts, veneer bolts, fence posts, poles and piling, and fuel wood are the more important items. Sales of stumpage and these products are an important source of cash income to timberland owners.

Almost one-half the forest land is on farms. Supplemental income from this source is especially welcomed since the cash income of 52 percent of the farms in South Carolina was less than $1,000 in 1945 (*13*). In addition to cash income, the woodlot provides the farmer with a cheap and convenient source of many of the products needed in running his farm, including rough lumber, fence posts, and fuel wood (fig. 3). Fence posts cut in 1947 were worth more than a million dollars to the farmers of South Carolina. In 1947, 17 million dollars worth of fuel wood was used in the

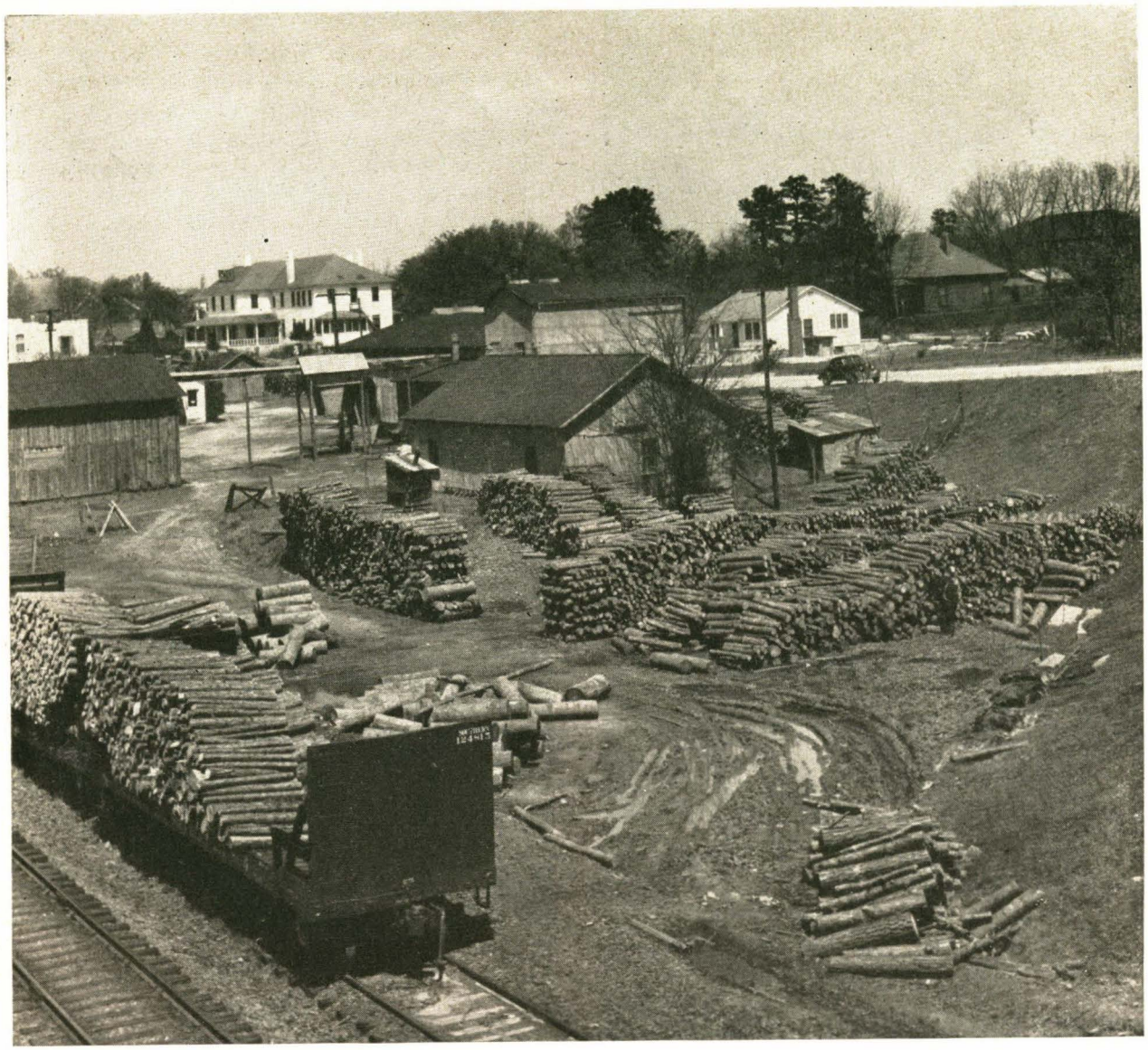

FIGURE 2. — *Forests mean jobs, income, and business to hundreds of rural communities throughout the State. In 1947, primary forest products were valued at 72 million dollars — second only to the cotton crop.*

rural homes in the State and in curing two-thirds of the tobacco crop, and the value of all primary forest products cut that year was as follows:

Primary forest product:	*Value,* [1] *1947*	
	Million dollars	*Percent*
Sawlogs	30	42
Fuel wood	17	24
Pulpwood	11	15
Veneer bolts	9	12
Other	5	7
Total	72	100

[1] Average value per unit of forest product times estimated production.

Further, the farm woodlot presents an opportunity to the farmer to put his time and equipment to profitable use in the woods during the offseason.

Equally dependent upon the local forests are the people who do not own any timber but who derive part or all of their livelihood from local woods and mill activities (fig. 4). Included in this group are the full-time woods and mill workers connected with the more permanent types of operations, as well as the tenants, subsistence farmers, and transient workers who work part time to provide a supplement to their incomes. To many tenants and subsistence farmers, woods and mill

FIGURE 3. — *One-fifth of the total volume of timber cut in 1947 was used for home heating, cooking, and curing tobacco. Rural and village people cut fuel wood worth about 17 million dollars.*

FIGURE 4. — *Many rural people are wholly or partially dependent upon woods work for their livelihood.*

work mean cash income to tide them over until the crop comes in.

Forests Support a 100-Million-Dollar Industry

Every year industries dependent upon forest products (fig. 5) pour millions of dollars' worth of commodities into trade channels. According to the 1947 Census of Manufactures (*14*), value added by manufacture in the forest products industries (lumber, paper, furniture, and allied products) amounted to 102.8 million dollars (fig. 6). These industries, wholly or partially dependent upon timber resources, accounted for 13 percent of the total value added by manufacture in the State, and in this respect ranked second only to the textile industry.

In 1948, one-half of all the firms engaged in manufacturing (fig. 7) were making forest products. The value of their plants and equipment amounted to 20

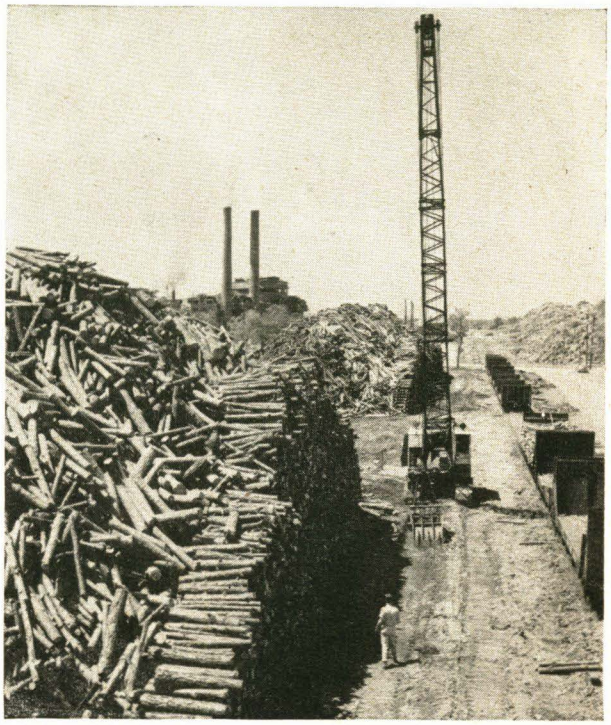

FIGURE 5. — *This large pulp and paper mill at Georgetown, is one of several in South Carolina and adjoining States that depend upon the State's forests for about a million cords of pulpwood a year.*

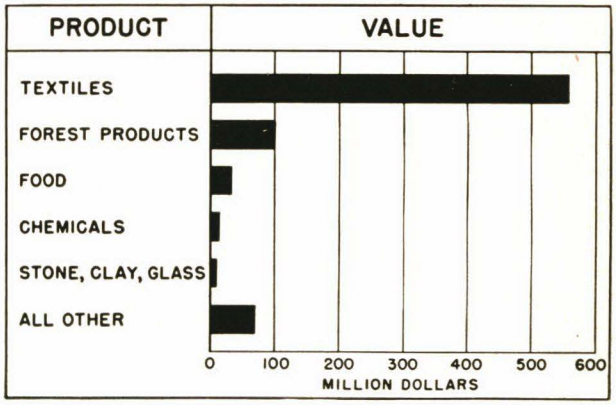

FIGURE 6. — *Value added by manufacture for principal industries in South Carolina, 1947. (Source: Bureau of the Census.)*

percent of all that invested in manufacturing enterprises. These facilities for converting wood to finished products furnished employment to 11 percent of all workers engaged in manufacturing and accounted for 18 percent of all profits derived from such activities. The forest industries further provide 30,000 jobs (table 1) and furnish the major means of livelihood to at least 100,000 people.

TABLE 1. — *Salaries and wages, employment, and average annual earnings per employee, by major industry group, 1947* [1]

Major industry group	Salaries and wages	Number of employees	Annual earnings per employee
	Million dollars	*Thousand*	*Dollars*
Textile products	261.0	124.6	2,095
Lumber and allied products	29.9	21.7	1,378
Paper and allied products	15.8	5.8	2,706
Food and kindred products	15.1	7.8	1,937
Furniture and fixtures	4.5	2.5	1,840
All other industries	50.7	26.2	1,931
All industries	377.0	188.6	1,999

[1] Data from Bureau of the Census.

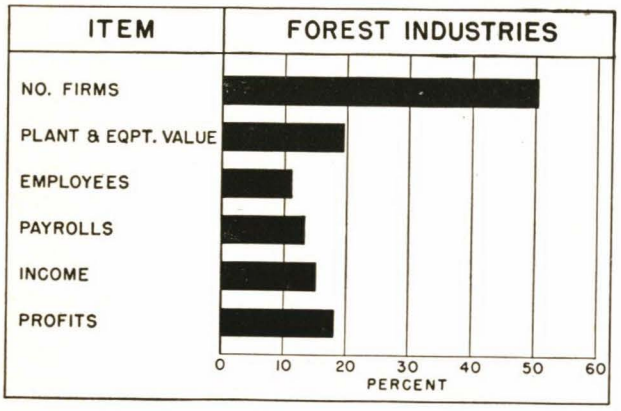

FIGURE 7. — *Relation of forest products industries to all manufacturing, 1948. (Source: Manufacturers Record Publishing Co.)*

Forest products industries provide an increasing number of jobs. According to the Census of Manufactures, the number of production workers in all industries increased by 39 percent from 1939 to 1947 (*14*). However, employment in the three forest products industries, lumber, pulp and paper, and furniture, increased by 63 percent (fig. 8).

The rise of the pulp and paper industry has opened up many new opportunities for employment. The number of production workers in this industry increased by

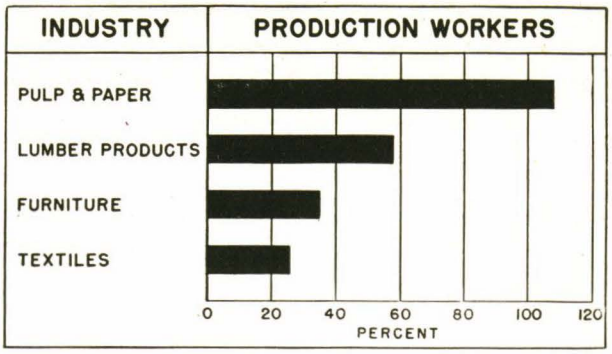

FIGURE 8. — *Increase in number of production workers in selected manufacturing industries, 1939 to 1947. (Source: Bureau of the Census.)*

over 100 percent from 1939 to 1947; the increase in lumber products industries was less than 60 percent. Pulpwood production and pulp and paper manufacture provided nearly 40 percent of the forest industry employment in 1944 (*16*), or almost as much as that furnished by the lumber industry (fig. 9). The pulp and paper industry not only means more jobs in South Carolina, but it also means better paid jobs. The annual earnings per employee exceed the average for all industries in the State by 36 percent (table 1).

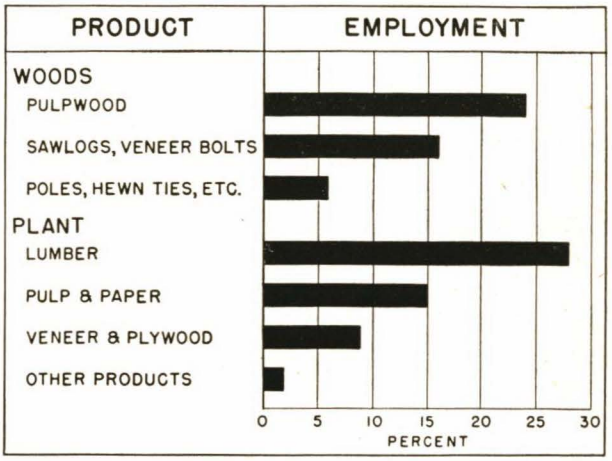

FIGURE 9. — *Distribution of employment in the forest products industries, 1944.*

FORESTS NEEDED TO SAFEGUARD WATER RESOURCES

Forest values are by no means confined to timber products. South Carolina's cities and major industries particularly require huge quantities of water. Just to mercerize a yard of cotton, for instance, requires about 30 gallons of water. The pulp and paper industry needs 50,000 to 120,000 gallons of water for every ton of

pulp it produces. About 100 gallons of water a day must be provided for every city dweller. In 1947, South Carolina produced 3,484,200 kilowatt hours of electricity, roughly two-thirds of which was generated by hydroelectric plants.

Well-stocked, properly managed forests help to assure an adequate supply of water. In many parts of the State, the original protective influence of forest cover has been largely destroyed by past land-use practices. In the Piedmont especially, rain water that once infiltrated down through the soil now runs directly into streams, carrying with it tons of soil from open fields and partially forested land. Many streams which once flowed clear along boulder-strewn water courses now are filled with sediment. This reduced channel capacity has increased the frequency and extent of flooding on rich bottomlands. As a result, these areas are becoming progressively wetter.

Sedimentation and uneven stream flow threaten the life and utility of hydroelectric plants. Reservoirs behind many of the smaller dams in the Piedmont have become almost completely filled with sediment. Further, water supplies for municipal and industrial use become progressively more expensive as the need for filtering sediment-laden surface water increases. In some cases textile mills have had to abandon surface water supplies and drill deep wells. Some cities have found it necessary to purchase and manage land to protect their water supply — further adding to the cost of water to the consumer.

Erosion from open fields and thinly stocked forest land in the Piedmont affects more than the surface water supply. The sediment carried by the surface water fills up many of the natural channels to the underground reservoirs. This tends to reduce the supply of underground water in the Coastal Plain, and makes it more difficult and expensive for industries and municipalities to obtain adequate supplies from deep wells.

Forest Land and Forest Types

Sixty-Two Percent of Area Forested

In 1947, 62 percent of the total land area of South Carolina was commercial forest land (fig. 10). These 11.9 million acres of commercial forest land are characteristically intermingled with cultivated fields and pasture (fig. 11). In 1947, 36 out of the total 46 counties in the State had more than half their total land area forested, while no county had less than 35 percent of its total land area in forests (fig. 12).

The pattern of intermingled forest and cleared land is determined largely by the suitability of land for agriculture. This in turn is influenced largely by soils and topography. Generally, the best soils are devoted to agriculture, leaving the rest for producing timber. Berkeley County, for instance, with a high proportion of poorly drained flatland and swamp, has 87 percent of its total land area in forest. With rising elevation and more rolling topography making for better soil drainage conditions, cleared farm land becomes increasingly more prevalent inland from the coast. These better soils, however, give way to a belt of excessively drained coarse sand hills, lying between the Coastal Plain of marine origin and the Piedmont Plateau.[2] Here, forested land again predominates over cropland.

[2] The Sandhills are considered as part of the Coastal Plain units for statistical purposes.

The Piedmont is characterized by rolling uplands and heavy soils originally of high agricultural value. Practically all the Piedmont has been in farm crops at one time or another. Under intense cropping practices large areas of land were rendered marginal for agriculture because of excessive erosion. The present heavily forested area through the lower Piedmont consists largely of abandoned farm lands.

Where the land slopes more gently and the soil is less eroded, agricultural land continues to predominate. The proportion of forest land drops below 25 percent in the peach belt of Spartanburg County and is only 35 percent in Anderson County in the northwestern part of the State.

Forest Area on the Increase

From 1936 to 1947, the area of commercial forest land increased by 1.2 million acres (table 2). The greatest increase occurred in the Piedmont area where a large amount of agricultural land has reverted to forest.

A further increase in forest land area can be expected. In 1936, 552,000 acres were not growing farm crops and were less than 5 percent stocked with trees; by 1947, the area of idle farm land rose to over a million and a half acres.

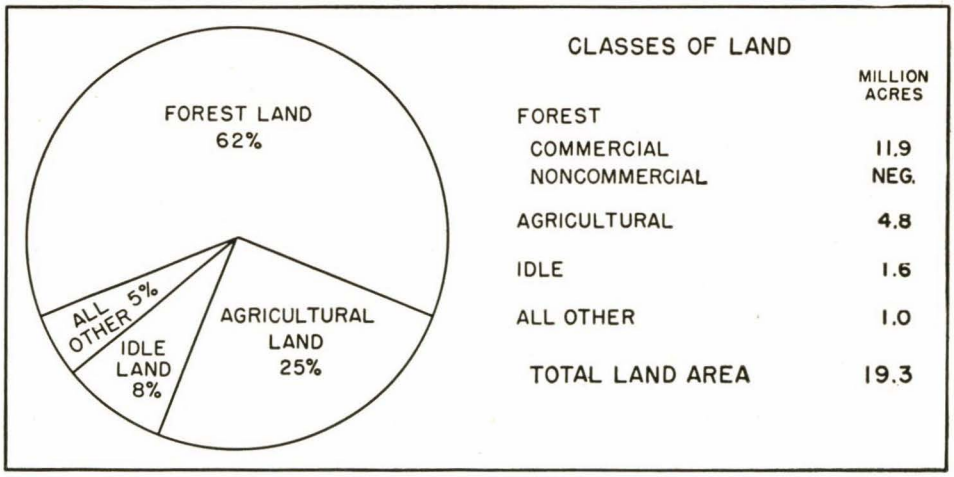

FIGURE 10. — *Land area of South Carolina by broad use class, 1947.*

FIGURE 11. — *The distribution of forest land ranges from small islands surrounded by cropland to extensive areas broken only by small clearings.*

TABLE 2. — *Area of commercial forest land, 1936 and 1947*

Survey unit	1936	1947	Increase	
	Acres	*Acres*	*Acres*	*Percent*
Southern Coastal Plain	2,993,000	3,026,300	33,300	1.1
Northern Coastal Plain	4,498,400	4,854,500	356,100	7.9
Piedmont	3,187,200	4,018,700	831,500	26.1
Total	10,678,600	11,899,500	1,220,900	11.4

The area of idle farm land is especially large in the Sandhills and in the upper part of the Piedmont (fig. 13). In Aiken County, where a large proportion of the soils are sandy and poorly suited to farm crops, 195,000 acres, or 28 percent of the total land area, were lying idle in 1947. In the Piedmont large areas of worn-out cropland are being abandoned. It is estimated that in Union County alone 5,300 acres have been taken out of cultivation annually in the past 10 years. Adjacent Spartanburg County has 144,000 acres of idle farm land.

While much of this idle land is only temporarily out of cultivation, a substantial part is suited only to timber growing and will eventually revert to forest. A study of changes in land use by the Soil Conservation Service on 10,943 individual farms in South Carolina revealed that 21 percent of the land which was idle, prior to the development of a conservation plan, was recommended for forest use. Thus, in the absence of a sudden spurt in land clearing, the reversion of part of this idle land to forest can be expected to add several hundred thousand acres to the present forest land area.

Some of this abandoned farm land, especially that in the Sandhills and upper Piedmont, will restock very slowly, or will restock with undesirable species, unless planted. On the other hand, abandoned farm land in the lower Piedmont and the agricultural districts of the Coastal Plain generally restocks satisfactorily in a relatively short time.

A reversal in the present trend in cropland abandonment is not anticipated in view of the declining acreage in crops. In 1948, the acreage of principal crops was 14 percent below the 1935-1944 average. At least partially responsible is the continuing farm-to-city movement, which has reduced rural population by 10 percent between 1940 and 1949.

Land Use History Influenced Present Forest Types

When the first colonists settled at Charleston, the forests of South Carolina were quite different from

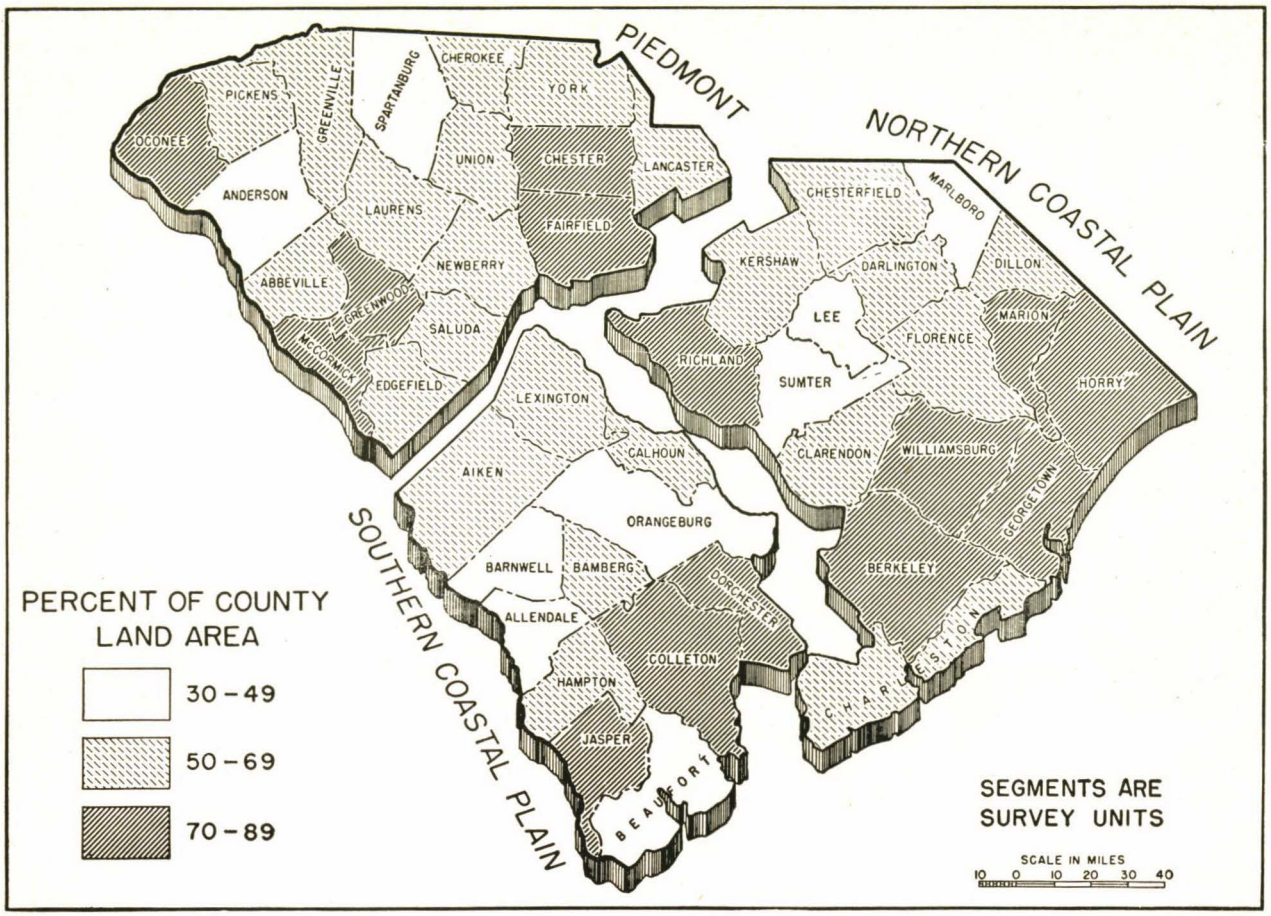

FIGURE 12. — *Percent of land in forest, by counties, 1947.*

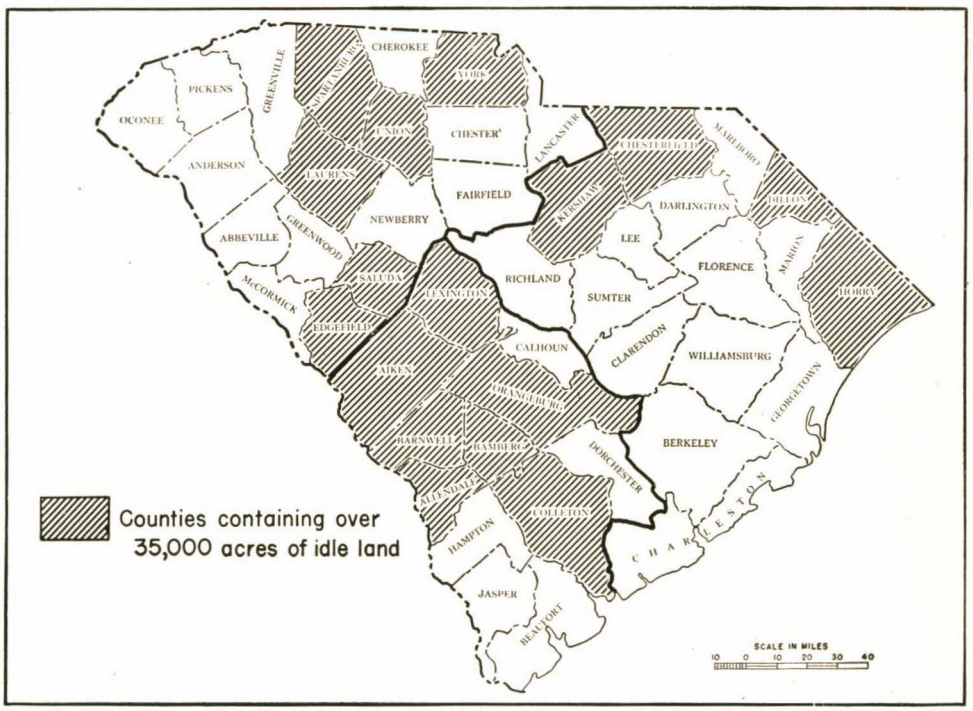

FIGURE 13.—*Location of heavy concentrations of idle farm land, 1947.*

FIGURE 14. — *The lowlands bordering the Coastal Plain streams are the natural home of sweetgum, white oak, ash, water oak, and other moisture-loving hardwoods.*

those of today. Cypress, blackgum, and tupelo gum grew abundantly in the poorly drained swamps of the Coastal Plain, while the broad alluvial river bottoms were the natural habitat for magnificent stands of sweetgum, white oak, water oak, ash, and yellow-poplar (fig. 14). Poorer-quality trees of these same species often occurred on the poorly drained flatwoods of the interstream areas lying close to the coast. On these lands they were often in competition with loblolly pine. On the drier ridges between the streams, and certainly upon the dry sands of the Sandhills area, pure stands of longleaf were the rule. According to the accounts of the earliest travelers, the Piedmont forests were chiefly hardwoods with the oaks, hickories, and chestnut common species on the higher lands. Undoubtedly, scattered stands of pine were also present. Along the Piedmont streams the characteristic growth was willow, beech, birch, black walnut, ash, yellow-poplar, and sweetgum.

As soon as settlement started, the activities of man began to change the character of the forest. Land clearing and subsequent land abandonment had the first and probably the most widespread effect. Encouraged by British colonial and mercantile policy, indigo and rice were grown in the coastal swamps bounding the Cooper and Ashley Rivers prior to 1700. These areas were essentially treeless, but soon the drive began to clear the hardwoods from the fresh-water swamps farther inland. Indigo production reached a peak by 1775 (*3*). After the Revolution, indigo cultivation practically ceased, but rice production flourished and thousands of acres of fields were carved from the virgin stands of hardwood and cypress. With the changed conditions following the Civil War, rice culture was abandoned and forests again occupied the land. At present, excellent stands of sweetgum and other hardwoods may be seen in the river swamps behind the levees of the old rice plantations. On the better-drained lands, pure stands of loblolly pine came in, but they are gradually being replaced by hardwoods, which are very aggressive on these natural hardwood sites (fig. 15).

The pattern of clearing, cropping, and abandonment occurred to a lesser extent on the flatwoods of the lower Coastal Plain, but at the height of the tidewater aristocracy in 1770, active land clearing, based at first upon corn and later upon cotton, was well under way in the upper Coastal Plain and Piedmont. Here family-size farms were common. They were usually on the better soils where hardwoods grew naturally. When crop yields fell off, the farmer cleared more good land nearby if it was available or moved on farther "up country." Scattered pines growing on the poorer soils reseeded the abandoned clearings.

This cycle of clearing and abandonment was usually repeated several times. It was intensified by a land-clearing boom around 1800 (3) following the invention of the cotton gin, and by land abandonment in the Civil War reconstruction period and again in 1921 following the appearance of the boll weevil. The effect was to convert large areas of forest, both in the Coastal Plain and Piedmont, from hardwood to pine. These pine forests have subsequently been modified toward more hardwoods by heavy cuttings of the pine, better fire protection which has favored the establishment of young aggressive hardwoods, and the tendency for hardwoods to invade the pine stands on the natural hardwood sites (fig. 16).

Early agricultural development bypassed large areas of longleaf pine in the Coastal Plain and Sandhills. In

FIGURE 15. — *Many of the pine stands growing on abandoned rice plantations near Charleston are now in the final stages of reverting to the original hardwood type.*

FIGURE 16. — *The flatwoods are contested by both pine and hardwood species, but eventually revert to the original hardwood forests unless there are repeated fires or special measures to perpetuate loblolly pine.*

the late 1800's, the production of naval stores from longleaf pine became important. The then prevalent practice of hewing boxes to receive the gum, when accompanied by fire and wind breakage, resulted in heavy losses in the virgin pine stands. Later, with the arrival of railroad logging and large band mills, liquidation of the longleaf pine progressed rapidly.

The longleaf lands are well-drained, fine, sandy soil in the Coastal Plain and dry sands in the Sandhills. They constitute the natural domain of pine and are less subject to invasion by hardwoods, aside from scrub oak (fig. 17). On the Sandhills, especially, various species of scrub oak often formed an understory in the longleaf stands, and they have become the typical cover where the longleaf pine has been eliminated by naval stores operations and lumbering. In the Coastal Plain, loblolly, and in some cases slash pine, has restocked much of the land, although longleaf still occurs in scattered patches.

The most significant effect that this long and varied land-use history had on the forests was to extend the pine species beyond their natural habitat. In 1947, 62 percent of all the commercial forest in the State was in the pine types.[3] In the Piedmont, where the original forest cover was chiefly oak and hickory, 74 percent of the forest is pine.

Hardwood-Type Area on the Increase

In recent years, some of the circumstances which once served to pereptuate and extend pine are disappearing. Better protection from fire and heavy cutting of pine in mixed pine-hardwood stands (fig. 18) have speeded up the natural succession of hardwoods on the wetter sites. As a result, hardwoods are gaining ground (table 3). Between 1936 and 1947, the area of pine types decreased about one-half million acres, while hardwood types increased by 1.6 million acres (fig. 19). The conversion of loblolly and shortleaf pine types to hardwood types was, to a large extent, offset by the restocking of abandoned farm land by these species.

Coastal Plain

Lowland hardwood types in the Coastal Plain increased by 38 percent (749,000 acres) between 1936 and 1947. With a wartime market for a diversity of timber products, including veneer bolts, pine and hardwood pulp-

[3] See Appendix for definition of forest types.

FIGURE 17. — *The dry upland sites of the Sandhills are the natural domain of longleaf pine.*

FIGURE 18. — *Pine is cut out of many mixed stands, leaving virtually pure hardwoods of low quality.*

TABLE 3. — *Change in area of commercial forest, by forest type and region, 1936 to 1947*

(*In million acres*)

Forest type	Coastal Plain		Piedmont		State	
	1936	1947	1936	1947	1936	1947
Loblolly pine[1]	3.3	3.1	0.7	1.0	4.0	4.1
Longleaf pine	1.8	1.1	.....	([2])	1.8	1.1
Shortleaf pine[3]	.1	.2	1.9	2.0	2.0	2.2
Lowland hardwoods[4]	2.0	2.7	.2	.4	2.2	3.1
Upland hardwoods[5]	.3	.8	.4	.6	.7	1.4
All types	7.5	7.9	3.2	4.0	10.7	11.9

[1] Includes pond pine type.
[2] 3,400 acres.
[3] Includes Virginia pine and redcedar type.
[4] Includes cypress type.
[5] Includes scrub oak type.

wood bolts, and pine sawlogs, many operators found it profitable to log the pine and the larger hardwoods out of the less accessible pine-hardwood stands fringing the swamps and river bottoms. This left a residual stand of small-sized, poor-quality hardwood.

The 688,000-acre reduction (table 3) in the area of longleaf pine represents a two-way squeeze on this forest type. With protection from fire, loblolly pine is replacing longleaf on the interstream uplands in the Coastal Plain, and in the Sandhills heavy cutting of the longleaf pine has converted large areas to scrub oak (fig. 20). In 1936, there were 153,000 acres of

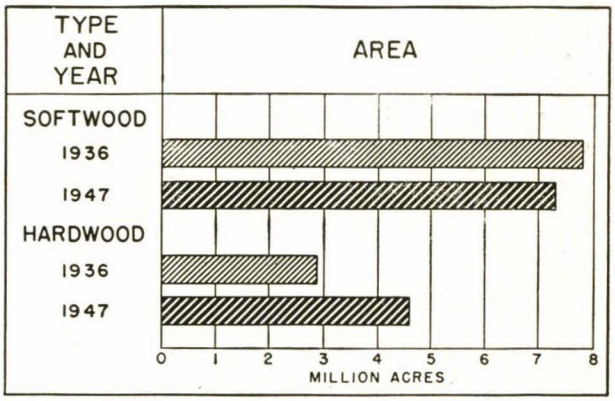

FIGURE 19. — *Area of softwood and hardwood types, 1936 and 1947.*

scrub oak; by 1947, this acreage had increased to 570,000 acres. This increase accounts for four-fifths of the total increase in upland hardwood types.

Piedmont

The shift from pine to hardwood types since 1936 has not been as marked in the Piedmont as in the Coastal Plain. As indicated by the 832,000-acre increase in forest area during the past decade, cropland abandonment is much more active here than in the Coastal Plain. Consequently, the large relative increases in hardwood area in the Piedmont have been offset to a large extent by corresponding increases in pine. Yet, in spite of the 15-percent increase in pine types, chiefly the loblolly pine, the proportion of forest area in pine types has decreased from 81 percent in 1936 to 74 percent in 1947, indicating a porportionately greater increase in hardwood types.

Even though the shortleaf pine type increased less than loblolly pine, land abandonment in the middle and upper Piedmont, where shortleaf pine predominates, is perhaps as active as in the lower Piedmont. While there undoubtedly was a substantial increase in the area of shortleaf and Virginia pine types as they invaded abandoned fields, the conversion of pine stands to hardwood by cutting offset to a large extent the increase in area of pine stands. For one thing, the red clay hills district, an area highly susceptible to erosion, was one of the first areas where a majority of farmers abandoned their lands during the post-Civil War reconstruction period. The pure pine stands that invaded these areas around 75 years ago are now being replaced by natural hardwood forests.

Littleleaf disease[4] also contributes to the conversion of pine to hardwood types. In a group of nine Piedmont counties where the disease is prevalent, 6.4 percent of the cubic-foot volume and 10.3 percent of the board-foot volume was in trees in advanced stages of the disease or which had recently died at the time the 1947 survey was made (fig. 21).

In both the Piedmont and the Coastal Plain, the effect of these changes is to reduce the area which will be growing pine in the next several decades. This is serious because the volume of pine is declining, about two-thirds of the wood cut in the State is pine, and the

[4] This disease, which attacks mainly shortleaf pine, is characterized by a gradual yellowing and thinning of the crown and eventual premature death of the tree. It is especially prevalent on heavy, poorly drained soils of worn-out farm land.

FIGURE 20. — *In the Sandhills scrub oak has replaced longleaf pine on large areas.*

FIGURE 21. — *The littleleaf disease of shortleaf pine is taking a heavy toll in some sections of the Piedmont.*

demand for pine tends to grow rather than decrease. Furthermore, the rather rapid trend toward a larger area of hardwood types indicates the situation may rapidly become worse unless corrective measures are taken. Aside from the need for pine, an increasing area of hardwood, as it is developing at present, is generally undesirable. Part of this new hardwood forest is composed almost entirely of cull species such as scrub oak, part represents cut-over lands thinly stocked with defective trees, and part represents fairly thrifty stands of low- to medium-quality hardwood for which there is very little market. None of these categories contributes much to the needs of forest industry or to a landowner income.

LANDOWNERSHIP: A FACTOR IN TIMBER SUPPLIES

Different timber owners have different aims. Public ownership carries a high responsibility for public welfare; private ownership reflects mainly economic incentives. Further, management procedures as well as the nature of the forest products enterprises are influenced by the size and distribution of forest landownerships.

Acreage of Public Forest Small

Public ownership in South Carolina is a relatively minor factor in its effect on the over-all land policies in the State (fig. 22). In the Nation, 25 percent of the commercial forest land is publicly owned, in South Carolina, only 7 percent. Also, only 7 percent of the sawlog volume of timber is in public ownership. About 60 percent of the public forest land, or 516,000 acres, is in national forests. The remainder includes Indian land held in trust, and State, county, and municipal forests.

FIGURE 22. — *Publicly owned forest land constitutes but 7 percent of the total forest land in the State.*

Private Ownership Determines Forest-Land Policy

Ninety-three percent of the forest land in South Carolina is owned by thousands of individual and corporate owners. Their reasons for owning forest land differ greatly. Forest land to some owners means a place to hunt and fish, to others a source of raw material, while to still a great many others, forest land means merely idle land. Often, people become forest owners quite unintentionally. In buying a farm, forest land is often part of the property and is acquired with no thought of managing it for forest crops.

Large Ownership Better Adapted to Good Forestry

Of the 4.2 million acres, forest and nonforest, in all private properties of 1,000 acres or more in South Carolina in 1946, 1.8 million acres are owned by people associated with the wood-using industries, as indicated in the following tabulation:

Class of ownership:[1]	Area owned [2]	
	Acres	*Percent*
Farmer	1,035,600	25
Lumber company and lumberman	1,026,800	25
Pulp company	642,900	16
Other forest industry	102,900	2
Other ownerships	1,342,400	32
Total	4,150,600	100

[1] Data taken from county tax rolls as of January 1, 1946.
[2] Includes forest and nonforest land on properties 1,000 acres and larger in size.

Since these owners are lumbermen, pulp companies, veneer plant operators and the like, they have reason to grow timber to assure themselves of a future supply. For the most part they also have the financial strength to undertake sustained-yield forestry. While present forest practices on a large part of this land still leave much to be desired, improvement in the past few years has been substantial.

The pulp companies — with a high stake in future timber supplies because of the heavy long-term investment in plants — are taking the lead in putting land under good forest management. A survey of cutting practices in 1945 revealed that nearly all the cutting on pulp company lands was classed as good.[5] Cutting practices on lands owned by lumber manufacturing enterprises, in the main, were classed as fair to poor. Cutting on all other ownerships was predominantly poor.

Small Ownerships Predominate

Only a small part of the forest land is affected by the better practices on lands owned by pulp and paper companies, for these ownerships in 1947 accounted for only about 6 percent of the total forest land. In 1945, 78 percent of the private commercial forest land was in ownerships of less than 5,000 acres. Over 100,000 properties averaged 69 acres of forest land.

Many obstacles to good forest management are inherent in small ownerships. In the first place, growing trees can at best be a sideline to the owner with only 50 to 100 acres of forest land. To the farmer, the farm woodlot is a minor and somewhat erratic source of income. Frequently, he lacks not only knowledge of the amount and value of the timber he has, but also financial incentive, the technical skill, and capital for handling timberlands. Pressure of low income to convert timber into cash encourages destructive cutting of timber stands. As a result, only a few of the small ownerships are under forest management. In 1945, only 15 percent of the commercial forest land on farms in the State was receiving the bare essentials of management. Thus, the smaller forest landowner, the main owner, must be encouraged to grow more and better-quality timber if South Carolina is to utilize the high timber-growing potential of its forest land.

[5] Good cutting requires good silviculture that leaves the land in possession of desirable species in condition for vigorous growth in the immediate future. Fair cutting marks the beginning of cutting practices which will maintain on the land a reasonable stock of growing timber in species that are desirable and marketable. Poor cutting leaves the land with a limited means for natural reproduction, often in the form of poor-quality trees of undesirable species.

Volume and Condition of Timber Stands

A Fourth of Live-Tree Volume Has Little Value

South Carolina's forests, in 1947, contained 11 billion cubic feet in living trees 5.0 inches d.b.h. and larger (table 4). Only three-fourths of this volume has economic value at the present time; the remaining fourth of the volume in living trees is cull and upper stems of hardwood saw-timber trees. As much as a third of the total hardwood volume is in cull trees and limbs of sound saw-timber trees, which may have potential use for fibre or chemical products but at present can yield little except fuel wood. The current demand for wood must be filled from the 8.3 billion cubic feet of timber in sawlog material, pole-timber trees, and the upper stems of softwood saw-timber trees (table 4).

Table 4. — *Cubic-foot volume[1] of all live trees on commercial forest land, by species group and kind of material, 1947*

Tree size and kind of material	Softwoods		Hardwoods		All species	
	Million cu. ft.	*Percent*	*Million cu. ft.*	*Percent*	*Million cu. ft.*	*Percent*
Saw-timber trees:						
Sawlog material	2,852	57	2,013	34	4,865	44
Upper stems	663	13	451	8	1,114	10
Pole-timber trees	1,291	26	1,529	25	2,820	26
Cull trees[2]	227	4	2,000	33	2,227	20
Total	5,033	100	5,993	100	11,026	100

[1] Excluding bark.
[2] Includes limbs of sound hardwood saw-timber trees.

Saw-timber Supply 30 Billion Board Feet

South Carolina has a better supply of saw timber in proportion to its forest area than any of the other four southeastern States. With only 14 percent of the area of the commercial forest land in the Southeast, South Carolina has 19 percent of the board-foot volume in sound trees (fig. 23).

Of the estimated 30 billion board feet in the State in 1947, 87 percent, or 25.7 billion board feet, is in saw-timber stands. These stands contain at least 1,500 board feet of timber per acre and they occupy 43 percent of the forested area (table 5). The remaining 13 percent of the saw-timber volume is scattered in other stands averaging less than 1,000 board feet per acre.

Softwood saw timber totals 17.6 billion board feet, 16.0 billion feet of which is in the softwood types (fig. 24). An additional 1.6 billion feet is scattered through 4.3 million acres of hardwood types. Hardwood saw timber totaled 12.0 billion board feet, 8.9 billion feet of which is in the hardwood types.

Three-fourths of the area in saw-timber stands in the State is in the Coastal Plain. They contain 21 billion board feet, or 71 percent of all the saw-timber volume in the State. Of this, 56 percent is softwoods.

Figure 23. — *About 43 percent of the commercial forest land in South Carolina is stocked with saw timber, but only 11 percent has large saw timber.*

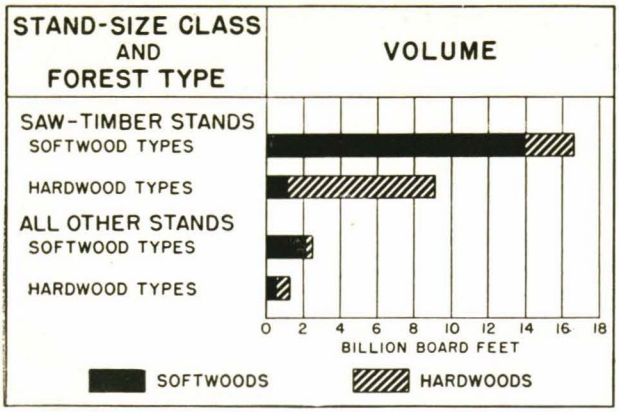

FIGURE 24. — *Distribution of saw-timber volume by stand-size class and forest type, 1947.*

Over a Third of Sound-tree Volume in Pole-size Trees

The supply of sound pole timber[6] in the State is the key to future productivity. Not only must the pole timber provide for about a quarter of the total forest drain, but enough must be left over to provide the growing stock for a future supply of sawlogs (fig. 25).

TABLE 5. — *Distribution of the commercial forest area, by stand size, 1947*

Stand size	Southern Coastal Plain	Northern Coastal Plain	Piedmont	South Carolina
	Percent	*Percent*	*Percent*	*Percent*
Large saw timber	11	15	5	11
Small saw timber	31	37	26	32
Pole timber	23	13	44	26
Seedling and sapling	24	30	18	24
Poorly stocked	11	5	7	7
Total	100	100	100	100

The 43.2 million cords of pole-size timber make up 36 percent of the total volume in sound trees 5 inches and larger. Only 17.2 million cords of this is in pole-timber stands (fig. 26), which make up about 26 percent of the commercial forest land in the State. The dividing line between small saw-timber stands and pole-timber stands is often not distinct (fig. 27), for practically all the remaining 26.0 million cords of pole trees is in saw-timber stands. These stands in the softwood types average 4.2 cords of pole-timber trees per acre, and in the hardwood types about 5.2 cords. Pole-timber stands contain only a slightly larger volume of pole trees: 5.5 cords in softwood types and 5.8 cords in hardwood types.

While saw-timber supplies are concentrated in the Coastal Plain, most of the pole timber is found in the Piedmont. Forty-four percent of the commercial forest in the Piedmont is in pole-timber stands while only 17 percent of the commercial forest in the Coastal Plain is pole timber. The Piedmont unit, with but a third of the commercial forest land in the State, has 57 percent of the pole-timber stands and 42 percent of the pole-timber volume.

The pole-timber stands in the Piedmont are more heavily stocked than those in the Coastal Plain. The difference between 8.3 cords per acre in the pole stands of the Piedmont and 7.5 cords per acre in the Coastal Plain reflects mainly a difference in the origin of the stands. Pole timber in the Piedmont is largely of old-field origin; pole timber in the Coastal Plain, for the most part, consists of residual stands where saw timber has been removed, and thus has a tendency to be sparse.

CHANGES IN TIMBER VOLUME, 1936-47

Total sound volume of trees 5.0 inches and larger decreased by 5 percent since the first intensive survey of forest resources in South Carolina was made in 1936. While the change in total volume has not been great, wide variation is displayed by the three survey units in the State. The southern Coastal Plain had 24 percent less volume in 1947 than in 1936, while the Piedmont showed a gain in volume of 14 percent (table 6). No significant changes in total stand volume were revealed in the northern Coastal Plain.

Saw-timber Volume Decreases

Most of the decrease in total volume can be attributed to the decrease in saw-timber volume. The total volume

TABLE 6. — *Change in total sound-tree volume,*[1] *1936 to 1947.*

Survey unit	Pine	Cypress	Hardwoods	All species
	Percent	*Percent*	*Percent*	*Percent*
Southern Coastal Plain	−31	−16	−18	−24
Northern Coastal Plain	− 4	+ 2	(2)	− 2
Piedmont	+11	....	+19	+14
State	− 8	− 5	− 2	− 5

[1] Comparison of volumes in trees 5.0 inches d.b.h. and larger.
[2] Negligible.

[6] Trees 5.0 inches to saw-timber size.

FIGURE 25. — *Pole-timber stands are found on 26 percent of the total forest land area.*

of saw timber in 1947 was estimated to be 29.5 billion board feet, including 2.3 billion feet in 12-inch hardwoods, which were not considered saw timber on the first survey. Omitting these hardwoods, the volume in 1947 was 27.2 billion feet, 10 percent less than in 1936.

The pine species have taken the brunt of the reduction in board-foot volume, decreasing by 12 percent, as compared to a hardwood volume reduction of only 6 percent (table 7). Longleaf and slash pine sustained the greatest proportionate reduction in volume, decreasing by 18 percent. The 17-percent reduction in shortleaf pine volume was hardly less severe.

While all parts of the State experienced reductions in saw timber, decreases in the northern Coastal Plain and the Piedmont were relatively small compared with the severe reduction in the southern Coastal Plain. Pine species in this part of the State declined by 29 percent and hardwoods by 16 percent.

Hardwood species, while showing a much smaller reduction than softwoods, varied widely among individual species; changes ranged all the way from a 36-percent decrease in white oaks to a gain of 25 percent in yellow-poplar. The cutting-out of most of the remaining old-growth bottom-land hardwood types in the State resulted in a one-third reduction in sweetgum saw timber.

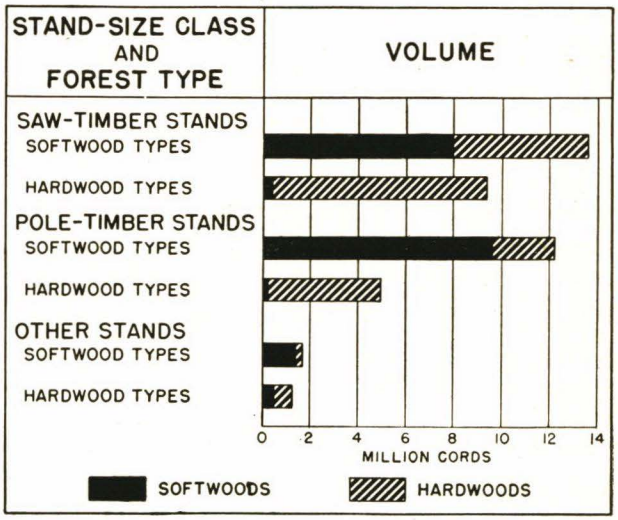

FIGURE 26. — *Distribution of pole-timber volume by stand-size class and forest type, 1947.*

FIGURE 27. — *Fifty-three percent of the volume of pole-timber trees is in saw-timber stands.*

TABLE 7. — *Change in saw-timber volume, 1936 to 1947.*

Survey unit	Pine	Cypress	Hardwoods [1]	All species
	Percent	*Percent*	*Percent*	*Percent*
Southern Coastal Plain	−29	−14	−16	−24
Northern Coastal Plain	− 6	− 3	− 2	− 4
Piedmont	− 2	....	− 3	− 2
State	−12	− 7	− 6	−10

[1] Comparison of volumes in trees 13.0 inches d.b.h. and larger.

TABLE 8. — *Change in volume of pole trees, 1936 to 1947* [1]

Survey unit	Pine	Cypress	Hardwoods	All species
	Percent	*Percent*	*Percent*	*Percent*
Southern Coastal Plain	−27	+18	−10	−14
Northern Coastal Plain	− 5	+80	+19	+14
Piedmont	+45	....	+57	+50
State	+11	+47	+17	+15

[1] Comparison of volumes in pine and cypress trees 5.0 to 8.9 inches d.b.h., hardwoods 5.0 to 12.9 inches.

Pole-timber Volume Increases

In contrast to the 10-percent reduction in saw-timber volume since 1936, pole-timber volume has increased by 15 percent (table 8). Like saw-timber volume, the degree of change in pole timber varied widely in various parts of the State and among species.

In the Piedmont, pole-timber volume increased 50 percent. Both pine and hardwood pole timber decreased only slightly less than saw timber in the southern Coastal Plain; pine by 27 percent and hardwoods by 10 percent. The change in pine pole-timber volume in the northern Coastal Plain was hardly significant, but hardwood species increased 19 percent.

STANDS IN POOR CONDITION TO GROW TIMBER

As a timber-producing plant, the forest falls far short of its potentialities; it has an unbalanced distribution of tree-size classes, individual stands are generally poorly stocked, and they contain a high proportion of cull and low-grade material.

A convenient measure of stocking or growing space utilized by trees is basal area.[7] In 1947, the stands had an average basal area of 50 square feet per acre. With optimum stocking and a balanced distribution of tree-size classes[8] the average basal area would be 76 square feet. Thus, only 66 percent of the total available growing space was being utilized by sound trees.

Unbalanced Distribution of Tree-size Classes

Contributing both to the deficiency in stocking and irregularity in timber yields is an unbalanced distribution of the basal area by tree size. Optimum basal areas for South Carolina compare with actual as follows:

	Basal area[1]	
Size of timber:	*Actual (M sq. ft.)*	*Optimum (M sq. ft.)*
Saw timber	283,672	507,886
Pole timber	190,775	289,900
Saplings	117,856	104,121
All timber	592,303	901,907

[1] In terms of basal area of all sound trees 1.0 inch and over.

Indicated, then, is a shortage of saw timber and pole timber but a surplus of sapling-size trees. While total basal area is two-thirds of optimum, saw timber is but 56 percent of optimum (fig. 28). The slightly better showing of pole timber is due entirely to the better supply of hardwoods in this class of timber, a factor that also contributes to the 13-percent oversupply of saplings. Over-all figures for the State, however, conceal significant differences in size-class distribution of basal area between the Coastal Plain and the Piedmont.

COASTAL PLAIN

In relation to the other tree-size classes, pole timber — both hardwoods and softwoods — is notably deficient in quantity in the Coastal Plain (fig. 28). The present pole-timber basal area is but 55 percent of the optimum. About 60 percent of this basal area is hardwood species, making the shortage especially acute among the softwoods.

Saplings are far better represented than the other classes of timber. However, by far the larger part consists of hardwood species.

[7] The sum of the cross-sectional areas, at 4.5 feet from the ground, of all trees 1.0 inch d.b.h. and larger on the average acre.

[8] Forest management experience in the South suggests that a stand should start out with at least 800 2- to 4-inch trees per acre. By the time the trees are 10 inches in diameter, the number of trees required for best growth is reduced to 300, and only 72 trees per acre would be considered optimum stocking by the time the trees were 16 inches in diameter.

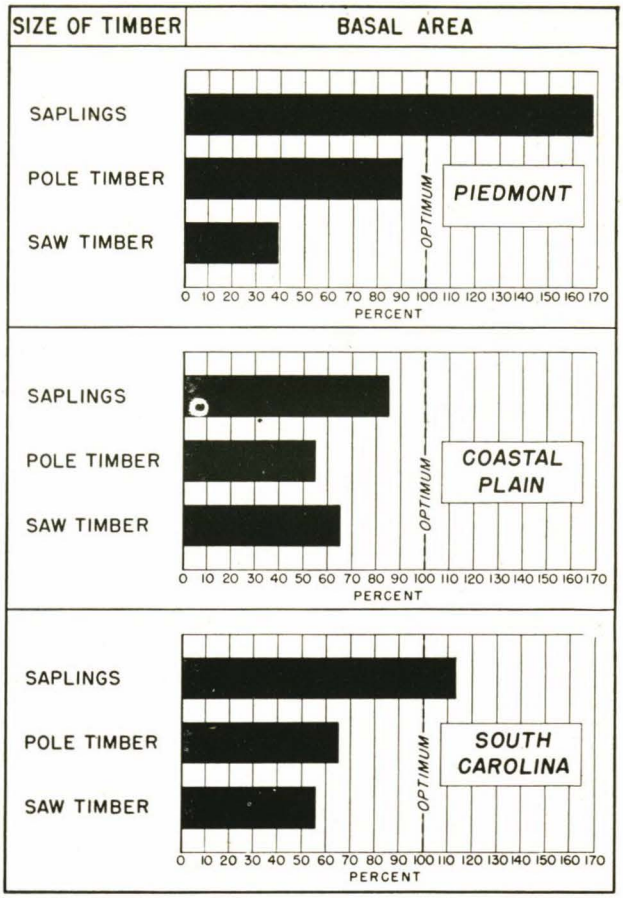

FIGURE 28. — *Comparison between present and optimum basal area by size of timber and region, 1947.*

Saw timber is in somewhat better supply than pole timber, but still a third short of the optimum amount. In this class of timber, however, softwoods are somewhat better represented than in the others, accounting for 58 percent of the total board-foot growing stock.[9]

Since today's pole timber represents tomorrow's saw timber, a deficiency in the former portends a reduction in the latter. From a fourth to a third of the saw-timber growth is represented by the volume of pole-timber trees growing into saw-timber sizes. Even now, largely because of the relatively small supply of pole timber, saw-timber stands are adding board-foot volume slower in the Coastal Plain than in the Piedmont, where the pole-timber supply is much better.

If the stands contain an ample backlog of seedlings and saplings, pole-timber deficiencies are temporary.

[9] A smaller proportion of saw-timber hardwoods in relation to softwoods arises from the fact that 10-inch hardwoods are not included as saw timber, whereas 10-inch softwood trees are considered saw timber.

This would appear to be the case among hardwood species where sapling stocking now exceeds optimum requirements. However, a large proportion of these hardwood saplings hardly qualify as potential crop trees (fig. 29). Hardwood species, being shade-tolerant, become established as an understory in older stands where, in their overtopped position, they just manage to stay alive. Upon release, some of these saplings will begin to grow and assume dominance in the stand, but a good many of them will continue to grow very slowly and for many years occupy space that could be given to young, fast-growing seedlings. Suggesting the extent to which saplings are found as an understory is the fact that 73 percent of all 2- and 4-inch hardwood trees are in pole and saw-timber stands. Further, as was noted earlier, many of the trees in the sapling stands were understory residuals in former old-growth stands. Not only are many hardwood saplings poor in form and quality, but they are frequently of low-value species — especially those hardwoods now invading pine stands.

PIEDMONT

Saw-timber basal area in the Piedmont is but 39 percent of the optimum amount (fig. 28). Compensating to some extent for this exceedingly short supply is the substantial backlog of young timber in the Piedmont. Here, pole timber is within 11 percent of the optimum amount; saplings exceed optimum by 68 percent.

Pines are better represented here than in the Coastal Plain. Two-thirds of the saw-timber basal area consists of pine. However, as in the Coastal Plain, hardwood species are much better represented in the smaller size classes than in saw timber.

The relatively good supply of young pine timber in the Piedmont is an outgrowth of past large-scale cropland abandonment. Declining farm prices, coupled with

FIGURE 29. — *A large part of the hardwood saplings are found in the understory of older stands, and are frequently of poor quality and of undesirable species.*

FIGURE 30. — *A million and a half acres of forest land are less than 10 percent stocked; many stands are left virtually denuded following heavy cutting.*

the boll weevil infestation, touched off a wave of abandonment shortly after World War I. Between 1919 and 1924, acreage of cropland harvested in the Piedmont dropped more than 600,000 acres, a 25-percent decline. Many of these abandoned fields seeded in quickly with pine and are now covered with dense stands of pole-size timber. Other areas where seed source was less plentiful restocked much more slowly. Frequently, only a few scattered trees became established at first, and complete restocking was delayed until these initial invaders began to bear seed.

Many of these old-field pine stands are extremely dense. Some of these small trees will reach pole size, and thinnings from these stands can help to meet the demand for pulpwood and fence posts. However, a large share of the small trees will drop out of the picture before they are large enough to make merchantable products. For this reason, it is necessary to discount the contribution that will be made to future saw timber by the present large quantity of saplings in this part of the State.

In the Piedmont, the role of hardwood saplings in building up the pole-timber basal area is much the same as in the Coastal Plain. They are generally of poor form, poor quality, and often of low-value species. In the absence of stand-improvement measures, only a small proportion will qualify as desirable growing stock.

The distribution of basal area by size classes in the Coastal Plain and in the Piedmont represents two rather distinct conditions. Temporarily at least, declining stocks of saw-timber size trees in the Coastal Plain will be further aggravated by a shortage of pole timber. In the Piedmont, the relatively large supply of young timber will go a long way toward easing the task of building up the extremely low supply of saw timber.

Forty Percent of Forest Area Poorly Stocked

The present stocking is not only short of the optimum and poorly distributed by size of timber, but it is also poorly distributed on the ground. Stands vary in stocking from completely denuded areas (fig. 30) to dense overstocked thickets. Over 4½ million acres, or 40 percent of the total forest area, is less than 40 percent stocked. Fourteen percent is under 10 percent stocked

(fig. 31). On the other hand, 2.4 million acres, or 20 percent of the total forest area, is overstocked.[10]

Overstocked stands are most common in the Piedmont. Over a quarter of the stands contain more than the desirable number of stems to qualify for optimum stocking. In the Coastal Plain only 17 percent of the forest land is overstocked.

It would be a mistake to assume that all overstocked saw-timber stands are overstocked with saw timber, or that all overstocked pole-timber stands contain too many pole-timber trees. In some instances this is true, but frequently a dense understory of saplings produces this overstocked condition; a fifth of the total basal area in the State is represented by these sizes. Hardwoods make up 55 percent of the basal area of these small trees and are abundant in both pine and hardwood stands.

Poor stocking is especially prevalent in the Coastal Plain, which includes the Sandhills. Twenty-nine percent of the total area is poorly stocked and 16 percent is nonstocked. About a fifth of the forest land in the State under 10 percent stocked is in the Sandhills (fig. 32). In the Piedmont, on the other hand, only 19 percent of the forest area is poorly stocked and 10 percent nonstocked.

[10] Stocking class, percent of full stocking: Nonstocked, 0 to 9; poorly stocked, 10 to 39; fairly well stocked, 40 to 69; well stocked, 70 to 100; overstocked, over 100.

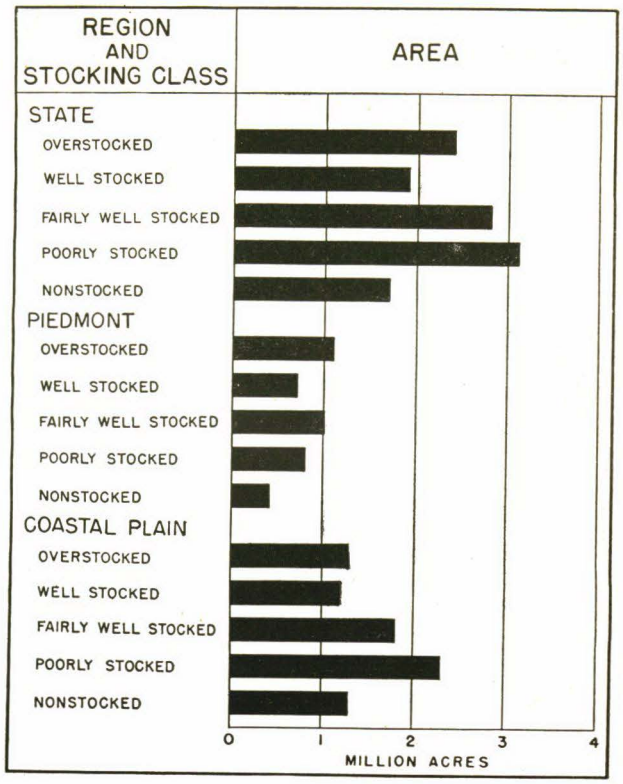

FIGURE 31. — *Distribution of commercial forest area by stocking class, 1947.*

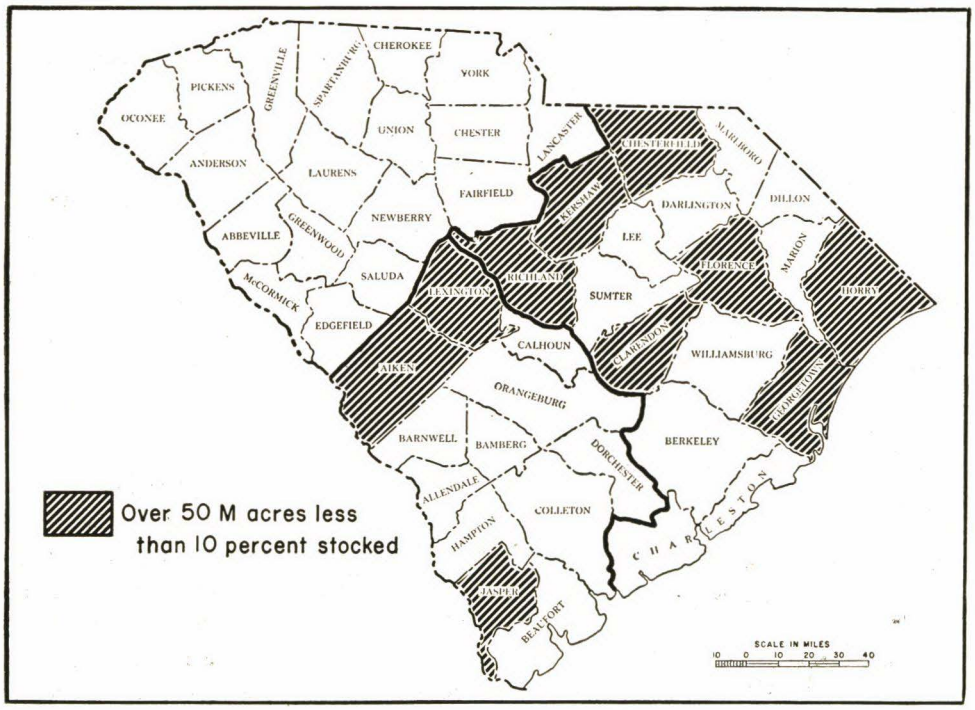

FIGURE 32.—*Location of heavy concentrations of poorly stocked forest land, 1947.*

The large area of poorly stocked and nonstocked stands is chiefly due to repeated fires and poor cutting practices. Between 1936 and 1947, about 850,000 acres of forest land burned over annually in South Carolina. By killing the young trees as soon as they became established, these fires prevented many areas from restocking. Also, in recent years, extensive areas of the remaining old-growth lowland hardwoods have been cut, leaving on the land only a scattering of small spindly trees which once formed the understory of the old stand. Hardwood stands 80 years and older, which in 1936 made up 38 percent of the total hardwood type area in the Coastal Plain, accounted for only 14 percent in 1947.

Natural regeneration on many of these areas is a slow process. Seed trees are widely scattered and often of undesirable species. By the time the small trees of the more desirable species are large enough to produce seed, the area is frequently choked with inferior hardwood sprouts and other shrubby vegetation. In some cases, even when a seed source is available following cutting, regeneration of the more valuable species, especially the pine, is retarded by an unfavorable seedbed of grass and heavy forest litter.

Poorly stocked stands are also associated to some extent with the 11-percent increase in forest land since 1936. The invasion of forests into abandoned fields usually extends over many years. Many areas which have only recently qualified as forest land [11] are in the initial stages of reversion to forest and consequently are understocked.

A Fifth of Basal Area of Live Trees Is in Culls

Since only sound trees have been considered in determining stocking, poor stocking does not necessarily mean a lack of stems in the stand. Frequently, especially in the hardwood stands, all the growing space is being utilized by live trees, but a large proportion of them are of such poor form, limby and defective, that they have practically no commercial value.

A fifth of the total basal area of all live trees 1.0 inch d.b.h. and larger is in these culls. Most of the culls are hardwoods; 31 percent of the basal area of live hardwood trees is classed as cull, as compared to but 5 percent for softwoods (fig. 33).

The various scrub oak species, which form the dominant cover on extensive areas of the Sandhills and frequently form an understory in pine stands on drier

[11] Areas 5 percent stocked with trees of commercial species are considered forest land.

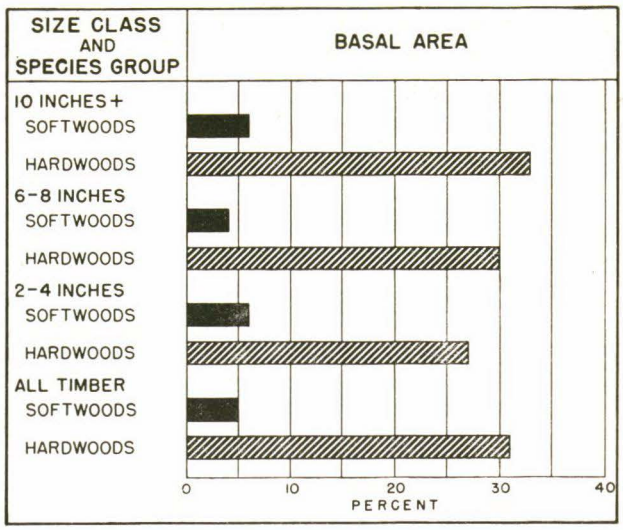

FIGURE 33. — *Proportion of the total basal area in cull trees by species group and size of timber, 1947.*

sites, make up the biggest part of the small cull trees. Also included as culls are the overtopped trees which obviously have no chance of becoming crop trees even if released. Among these overtopped trees the distinction between a cull tree and a sound tree cannot be drawn sharply, since merchantability cannot serve as a yardstick. Some of the sound trees will undoubtedly become culls as the stand develops. Presumably, many of the sound trees will respond to stand improvement measures and are in this sense potential crop trees.

The saw-timber cull trees are often of high-value species, but because of excessive rot, numerous and large limbs, and crook there is not enough merchantable wood in them to pay the cost of harvesting. Yet they take up growing space; often widespreading limbs will preclude the establishment of young growth for a considerable radius around the tree. They account for 33 percent of the total basal area of live hardwood saw-timber size trees.

The low-quality hardwoods are concentrated in the Coastal Plain and in the mountains (fig. 34). They are especially abundant in Sumter, Florence, Marion, and Dillon Counties in the northern Coastal Plain, where 52 percent of all the cull hardwood volume in the State is located. In Sumter County, cull hardwoods amount to nearly 6 cords per acre of forest land, and in Florence County 42 percent of the volume of live hardwood trees is in cull trees.

Clearly, then, the productivity of the forest stands depends not only upon the density of the stands, but also upon the quality of the stems in the stands. In

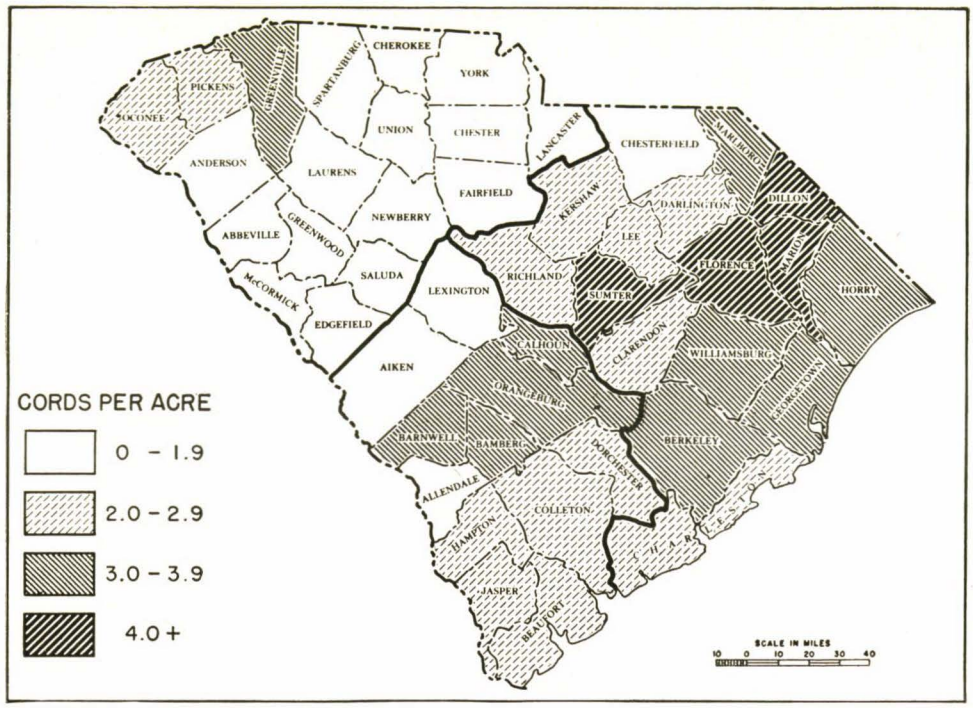

FIGURE 34. — *Cords of hardwood culls per acre of commercial forest land, 1947.*

many cases, the task of increasing the number of desirable trees, either by planting or by natural means, involves, first of all, a removal of the cull trees.

CHANGES IN FOREST CONDITIONS, 1936-47

A comparison of the findings of the 1947 survey with those of 1936 provides an insight into some of the changes taking place in forest conditions. Some changes constitute improvements, while others are in the nature of further deterioration of stand productivity.

Stocking Increases

In spite of the 5-percent decrease in total volume of sound trees 5.0 inches and larger in the 12-year period, the basal area of all sound trees 1.0 inch and larger increased by 15 percent. While the increase was proportionately greater in the sapling-size trees (fig. 35), it was by no means confined to this class of timber. With the exception of reductions in saw timber and hardwood pole timber in the southern Coastal Plain, all classes of timber throughout the State showed increases in basal area.

With 11 percent more forest land, a greater basal area of sapling-size trees was to be expected and the 34-percent increase contributed significantly to the basal area. Not all the increase can be attributed to the greater forest area, since softwoods, which characteristically invade abandoned lands, increased by only 26 percent, as compared to 42 percent for hardwoods. The better supply of hardwood saplings appears to be due to their vigorous invasion of hardwood and pine stands — a partial result of improved fire protection.

Only in the southern Coastal Plain has the decline in basal area paralleled the decline in volume. Here, the 29-percent reduction in pine saw-timber volume

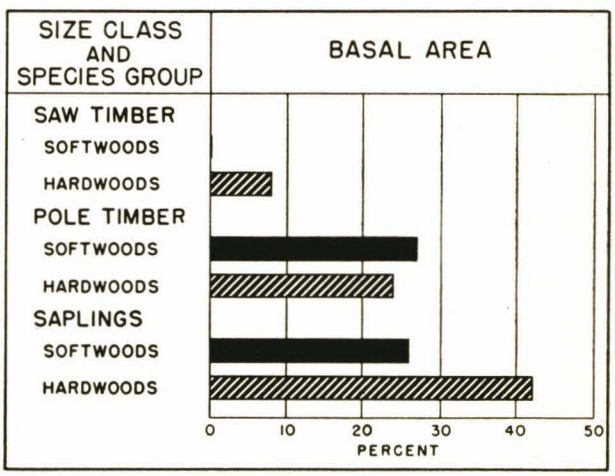

FIGURE 35. — *Percent increase in basal area by size of timber and species group, 1936 to 1947.*

since 1936 has been accompanied by a 24-percent decrease in basal area. While both basal area and volume of saw-timber and pole-timber hardwoods declined, volume decreased more than basal area in both classes. In all other classes of timber throughout the State, basal area increased in spite of decreases in volume. Even where volume increased, as in the case of pole timber, basal area increased even more.

Stand Quality Declines

The decline in volume since 1936 in the face of an increase in basal area indicates a general downgrading of the stands. As the best stands are cut and the best trees in the stands are removed, the trend is toward a higher proportion of shorter trees of poorer form. Further, the proportion of defect per tree, notably among the hardwoods, increases as the better-quality trees are removed.

The result of this decline in stand quality means a lower average net volume per tree. In 1936, the average volume per saw-timber tree was 123 board feet; in 1947, it was 105, a 15-percent decrease (table 9). This reduction in volume is only partially explained by a shift to smaller-diameter timber. The slight decrease in average size of the timber since 1936 can account for but a small part of the total change. Most of the change represents shorter boles, poorer form, and more defect.

Not only has the quality of the sound trees decreased, but the proportion of cull material in the stands has increased. Cull tree volume, mainly hardwoods, now makes up 18 percent of the total volume, compared to 11 percent in 1936.

Slight Decrease in Diameter of Timber

Apparently, the shift from old-growth timber to small second growth was largely completed before 1936. In spite of the extremely heavy wartime drain on saw timber, the average diameter of saw timber dropped only three-tenths of an inch (fig. 36). Only in the largest diameter classes has the number of trees decreased (fig. 37). These reductions in the number of large trees, while sizable in terms of percent, actually do not affect the average diameter of the timber very much. Only about 6 percent of the total number of saw-timber trees are over 19 inches in diameter. The proportionately greater increases in number of small trees was the principal reason for the slight reduction in the average diameter of the timber.

Hardwoods Increasing

The relatively large increase in hardwood types since 1936 has been paralleled by only a small increase in the proportion of hardwood basal area (fig. 38). What has happened is that the removal of a relatively small number of pines served to convert large areas of pine type to hardwood. For instance, the removal of the few scattered overstory pines in the Sandhills served to

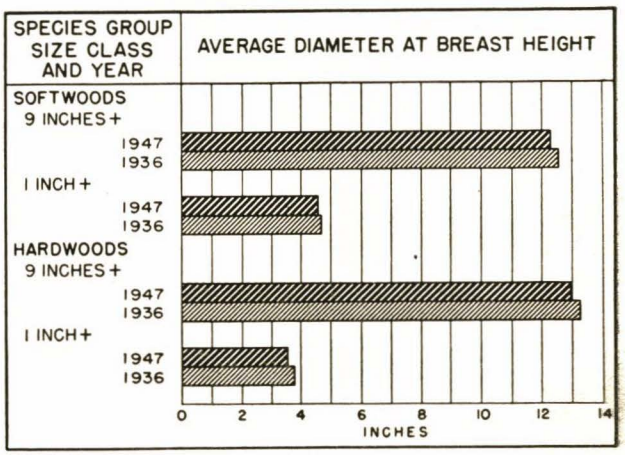

FIGURE 36. — *Change in average tree diameter by species and size of timber, 1936 to 1947.*

TABLE 9. — *Change in the average net board-foot volume per tree, by size class and species group, 1936 to 1947*

Diameter class (inches)	Softwoods			Hardwoods[1]			All species		
	1936	1947	Change	1936	1947	Change	1936	1947	Change
	Bd. ft.	*Bd. ft.*	*Percent*	*Bd. ft.*	*Bd. ft.*	*Percent*	*Bd. ft.*	*Bd. ft.*	*Percent*
10–12	60	55	− 9	57	57	....	60	56	− 7
14–18	176	159	− 9	121	122	+ 1	149	140	− 6
20–24	446	403	−10	315	261	−17	373	315	−16
26+	1,019	863	−15	731	537	−27	833	651	−22
All sizes	117	98	−16	135	117	−13	123	105	−15

[1] Does not include 10-inch diameter-class trees.

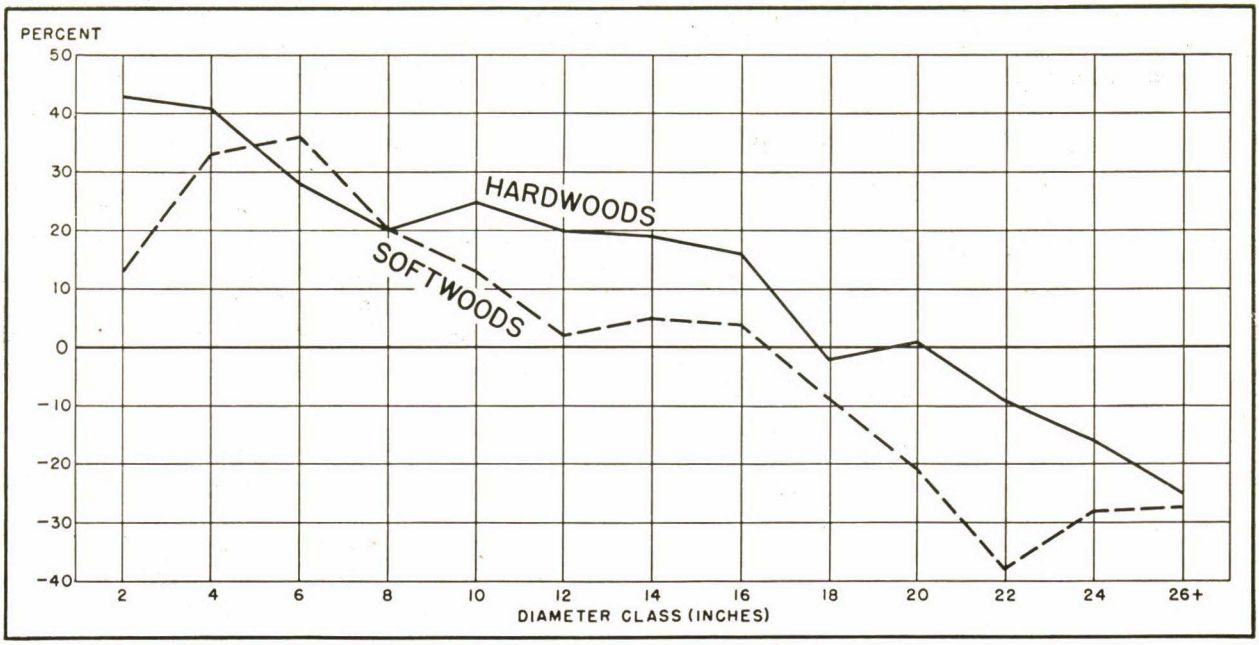

FIGURE 37. — *Percent change in number of trees by species group and diameter class, 1936 to 1947.*

convert thousands of acres of longleaf pine type to scrub oak. For the most part, hardwoods did not increase much; they were already present in the understory. Similarly, in the lower Coastal Plain, the cutting out of a small number of mature pine[12] in mixed loblolly pine-hardwood types frequently left pure hardwood stands. The reduction in pine stocking in mixed pine-hardwood stands of the Sandhills and lower Coastal Plain was largely offset by an increase in pine stocking in the Piedmont. Here, active restocking of partially stocked, abandoned cropland resulted in a large increase in the number of pine trees without an accompanying increase in pine types. Part of the Piedmont increase consists of dense thickets of Virginia pine, which at best can only amount to pulpwood. These are hardly a desirable trade for valuable loblolly pine in the Coastal Plain.

Even though the shift to hardwoods, for the State as a whole, has been rather slow, hardwood invasion is critical in local areas. In the northern Coastal Plain, softwoods make up 53 percent of the basal area of saw timber, but only 31 percent of the basal area of the saplings. A large part of the shift to hardwoods has taken place since 1936, as the proportion of the sapling basal area in hardwoods has increased from 61 to 69 percent in the 12-year period. As these young trees mature, the trend toward more hardwoods will stand out even more than at present.

Many pine stands will undoubtedly revert to hardwoods in spite of efforts to perpetuate pine. Fortunately, steps can be taken to partly balance these losses. Idle, denuded, and poorly stocked forest land can be planted to pine. Special efforts to control hardwoods on sites well suited to growing high-quality pine will go a long way toward tipping the scales in favor of the valuable pine species.

[12] According to Forest Survey type definitions, only 25 percent of the dominant and codominant trees in the stand have to be pine to qualify stand as pine type.

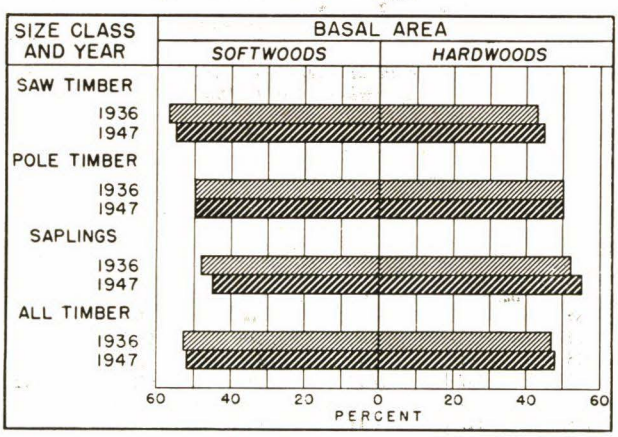

FIGURE 38. — *Change in proportion of softwood and hardwood species by size of timber, 1936 to 1947.*

Forest Growth Short of Timber Needs

How well is the forest as a timber-producing plant providing for the State's forest industries? As already indicated, in the period 1936 to 1947 there was a 5-percent decrease in the total growing stock volume and a 10-percent decrease in saw-timber volume. The heavy demands for timber for World War II contributed to this reduction, as drain reached a peak of 5.7 million cords in 1942. By 1946, timber drain was based upon peace-time markets, but even then total drain was 5.0 million cords (fig. 39), 25 percent above that of 1936.

In 1946 the total growth of sound timber was 5.6 million cords — 11 percent more than drain. From a practical standpoint this is rather misleading since all of this growth is not equally well-suited to meeting South Carolina's timber needs. An examination of growth and drain by class of material and species groups reveals serious growth deficiencies in the kind of timber most urgently needed by the forest industries. Particularly disturbing is the fact that, almost without exception, drain exceeds growth in the same classes of timber which are already in short supply or show the greatest decline since 1936. Saw-timber drain is making deep inroads into saw-timber growing stock in the Piedmont, where the shortage in this class of timber is already acute, and also in the southern Coastal Plain, which sustained the greatest reduction in saw-timber volume since 1936. In the Coastal Plain, drain on the pole timber exceeds growth.

Saw-timber Growth Less Than Drain

In 1946, net saw-timber growth amounted to 1,457 million board feet, 63 million feet, or 4 percent, less than commodity drain (fig. 40). Drain on softwood saw timber exceeded growth by 35 percent in the southern Coastal Plain, by 27 percent in the Piedmont, and 15 percent for the State. Soft hardwoods (gums, soft maple, and yellow-poplar) are faring better than the softwoods in these areas. Drain on the soft hardwoods exceeded growth by 11 percent in the southern Coastal Plain and by 26 percent in the Piedmont.

Much of the saw-timber growth is concentrated in the smaller trees, which yield a relatively small amount of lumber per cubic foot of wood. The drain, on the other hand, comes mainly from the larger trees, which yield a larger amount of lumber per cubic foot. This means that a greater cubic volume of wood made up of small trees is required to saw out a thousand board feet of lumber than is required for large trees. The combined effect of this, and the preference for large trees for commodities, results in indicating growth in excess of drain when the total wood volume involved is computed in cubic feet. This does not vitiate the statement that saw-timber drain in board feet exceeds growth.

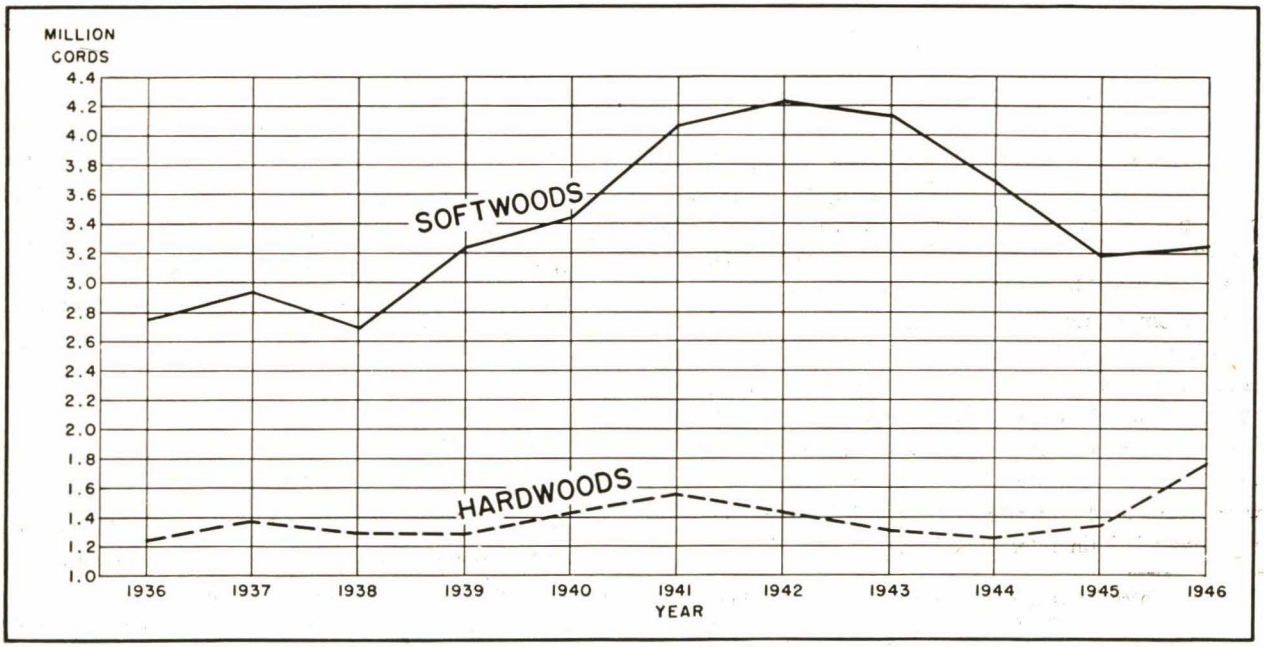

FIGURE 39. — *Total drain on trees 5.0 inches d.b.h. and larger by species group, 1936-46.*

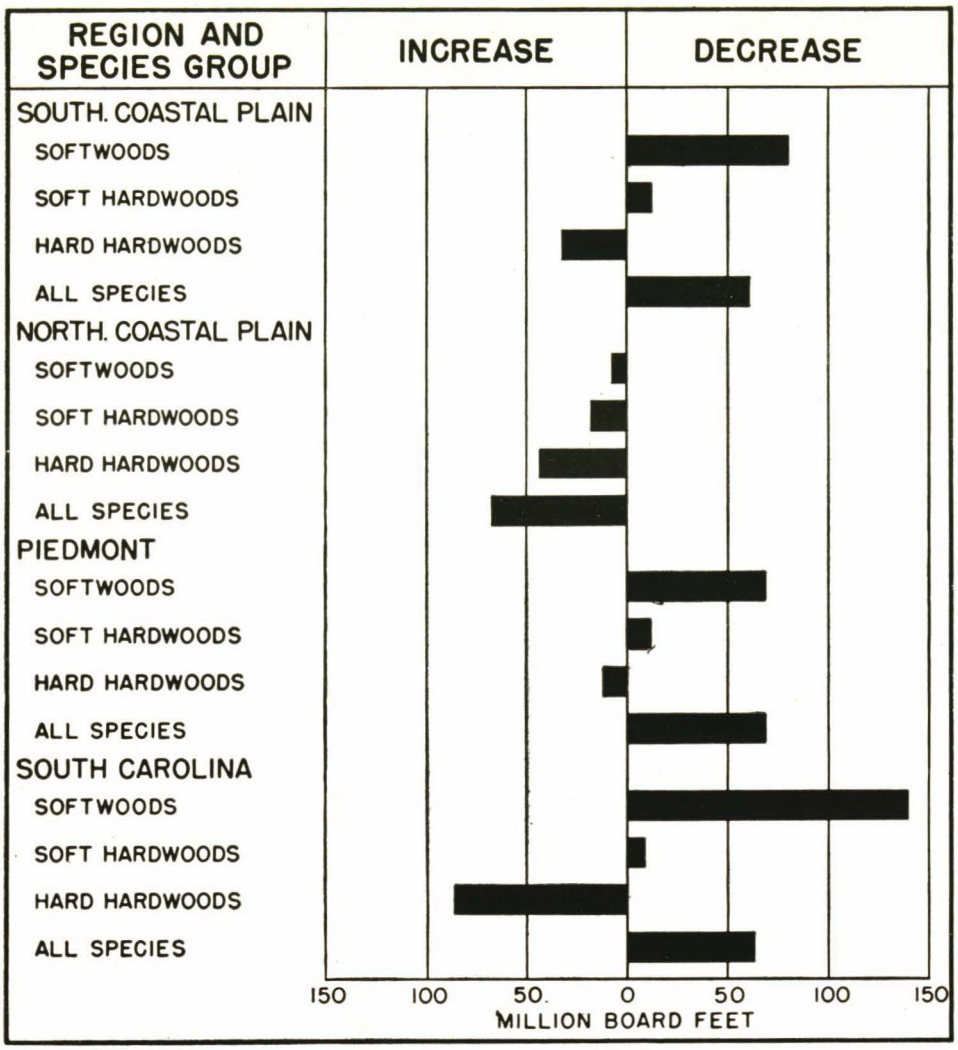

FIGURE 40. — *Net change in saw-timber growing stock, 1946.*

Net growth of hard hardwood saw timber (oaks, hickories, etc.) exceeded drain throughout the State. Also on the plus side was the excess growth over drain for all species groups in the northern Coastal Plain.

An unfavorable balance of growth and drain may result from either a high drain intensity [13] or a low growth ratio,[14] or both. In many instances high growth ratios are offset by still higher drain intensities. In 1946, softwoods were growing at a rate of 53 board feet per thousand feet of growing stock; hardwoods were growing at a rate of 44 board feet. But softwoods were being used at a rate of 60 board feet compared to a hardwood drain intensity of only 38 board feet.

[13] Drain intensity is the volume of annual commodity drain per unit of growing stock.

[14] Growth ratio is the volume of annual growth per unit of growing stock.

Softwood saw-timber drain intensities are especially high in both the southern Coastal Plain and the Piedmont, where this class of timber is declining most rapidly (fig. 41). In the Piedmont, softwood saw timber is growing at the rate of 58 board feet per thousand feet of growing stock but is being cut at a rate of 73 board feet. Drain intensity in the southern Coastal Plain is somewhat lower, but so is the growth ratio. Here the drain intensity is 68 board feet and the growth ratio only 50 board feet.

The favorable growth and drain balance in the northern Coastal Plain is the result of comparatively light drain intensity rather than high growth ratios (fig. 41). Hard hardwoods and soft hardwoods grow at about the same rate but the drain intensity on the

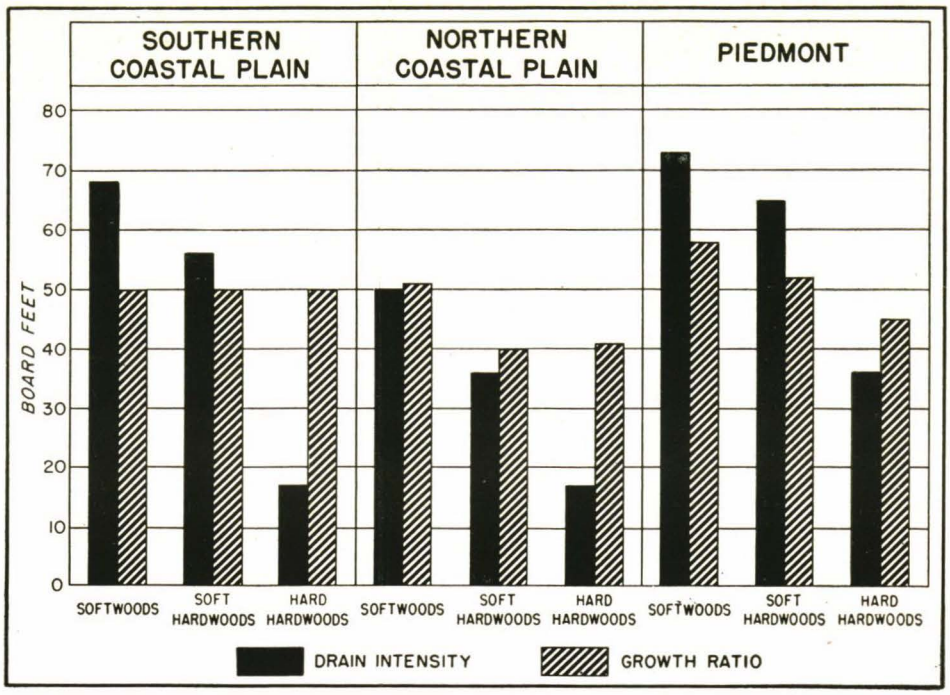

FIGURE 41. — *Saw-timber growth and drain per thousand board feet of growing stock, by region and species group, 1946.*

former group is much lower, less than half the growth ratio.

With an average pine site index of 69 in the Coastal Plain, compared to an average site index of only 56 in the Piedmont, growth ratios would normally be higher in the Coastal Plain. A partial explanation for a higher growth ratio in the Piedmont is found in the greater contribution of pole timber to net growth of saw timber. In the Coastal Plain 25 percent of the saw-timber growth is a result of pole-timber ingrowth, i.e., pole-timber trees growing into saw-timber sizes (fig. 42). In contrast, pole-timber ingrowth amounts to 34 percent of the total saw-timber growth in the Piedmont.

Another factor that affects the growth and drain balance is mortality, which includes losses resulting from fire, insects, disease, and other natural causes. In South Carolina, where the timber is predominantly second growth, these losses are not very important except in localized areas where the littleleaf disease occurs in the Piedmont. In 1946, the volume of timber killed by fire and natural causes amounted to 117 million board feet, or about 7 percent of the total drain on the forest. Even if mortality had been completely eliminated, the softwood saw timber in South Carolina would still have been overcut in 1946. These losses could be reduced by better fire protection and prompt removal of the unthrifty trees in the stand. However, high drain

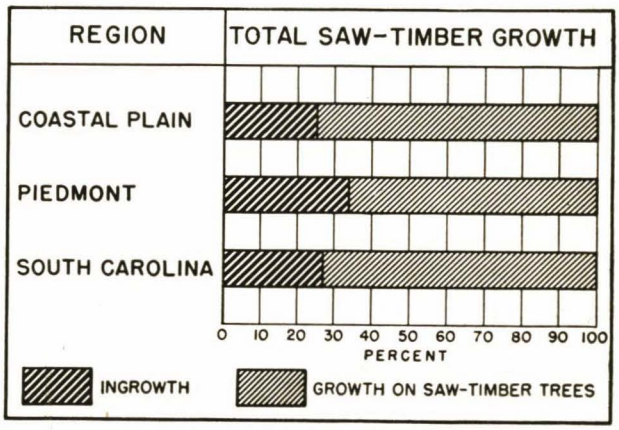

FIGURE 42. — *Percent ingrowth of net saw-timber growth, by region, 1946.*

intensities along with shortages in growing stock present the chief obstacles to closing the gap between saw-timber growth and drain.

Pole-timber Growth Less Than Drain

In spite of the increase in pole-timber volume since 1936, pole-timber growth in South Carolina was less than drain in all species groups in 1946. In the Coastal Plain where pole timber was already in short supply, drain was nearly three times as much as growth. Softwoods showed the greatest deficit (fig. 43).

In the Piedmont, on the other hand, pole-timber growing stock is increasing. In 1946, softwood growth exceeded drain by 64 percent, and growth in soft hardwoods exceeded drain by 102 percent. Only among the hard hardwoods was growth inadequate to meet the drain.

HIGH DRAIN INTENSITIES

Pole timber is declining in the Coastal Plain because of high drain intensities and low growth ratios. Pulpwood procurement methods largely determine the local drain intensity on softwood pole timber. In an effort to keep transportation costs as low as possible, there is a natural tendency to obtain as much wood as possible near the plants. Consequently, the areas in the Coastal Plain surrounding the large paper mills were not only the first to feel the pulpwood drain, but have sustained a more intensive drain than the outlying Piedmont region. Pulpwood drain in the Coastal Plain hit a peak in 1942; in the Piedmont it rose sharply after 1942, reaching a peak in 1944. In 1946, in spite of the better supply of pine pole timber in the Piedmont, total drain intensity on softwoods was but 24 cords per thousand cords of pole-timber growing stock, compared to a drain intensity of 38 cords in the Coastal Plain (fig. 44).

Fuel wood represents the principal item of hardwood pole-timber drain. On the soft hardwoods, drain intensity is not high in either the Piedmont or the Coastal Plain, but on the hard hardwoods it is even higher than on the softwoods. The drain intensity on hard hardwoods is especially high in the Coastal Plain, where it amounts to 45 cords per thousand cords of growing stock. This is 13 cords higher than in the Piedmont.

The heavy cutting of the hard hardwood pole trees reflects the extensive use of fuel wood to cure tobacco in the northern Coastal Plain. Here, where 95 percent of all this pole timber goes into fuel wood, the drain intensity is 55 cords, the highest of any species group in any region of the State.

LOW GROWTH RATIOS

Further widening the large gap between pole-timber growth and drain in the Coastal Plain are the exceedingly low growth ratios, which are but a fraction of those in the Piedmont. Softwoods are growing only 11 cords per thousand cords of growing stock in the Coastal Plain, compared to 39 cords in the Piedmont. The

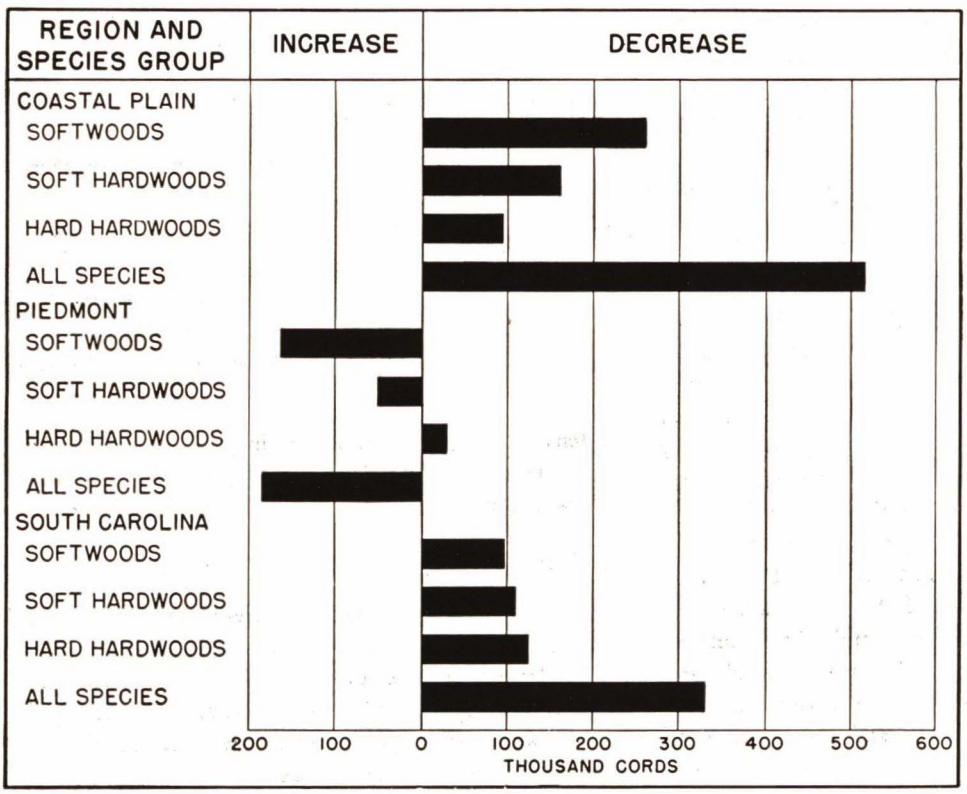

FIGURE 43. — *Net change in pole-timber growing stock, 1946.*

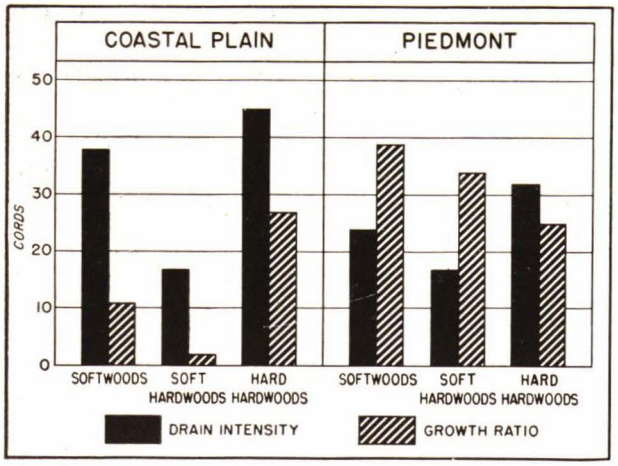

FIGURE 44. — *Cords of growth and drain per thousand cords of pole-timber growing stock, by region and species group, 1946.*

difference in growth ratios between the two regions is even greater among the soft hardwoods. These species grow only 2 cords compared to 34 cords in the Piedmont. Only the hard hardwoods show a favorable growth ratio, but even their rate of 27 cords is not enough to offset the correspondingly high intensity of drain.

Net pole-timber growth depends upon (1) the rate at which individual trees are growing, (2) the rate at which saplings are growing into pole timber, and (3) the rate at which pole timber is moving into saw-timber sizes. Pole-timber growing stock represents but a middle stage in the process of growing trees from seedlings to saw timber. During the growth period, saplings grow into pole size and add their volume to the growth of trees already pole-timber size. At the same time, some pole trees grow to saw-timber size, diminishing the pole-timber growing stock by their volume. Net pole-timber growth, then, is obtained by subtracting outgrowth and mortality from the sum of ingrowth and growth on pole-size trees (fig. 45).

The growth rate of individual trees differs little between the Coastal Plain and the Piedmont. Yet, net growth in the Coastal Plain, in all species combined, is but a third of that in the Piedmont.

Low net growth in the Coastal Plain can be traced to a low ingrowth of saplings and a rapid outgrowth

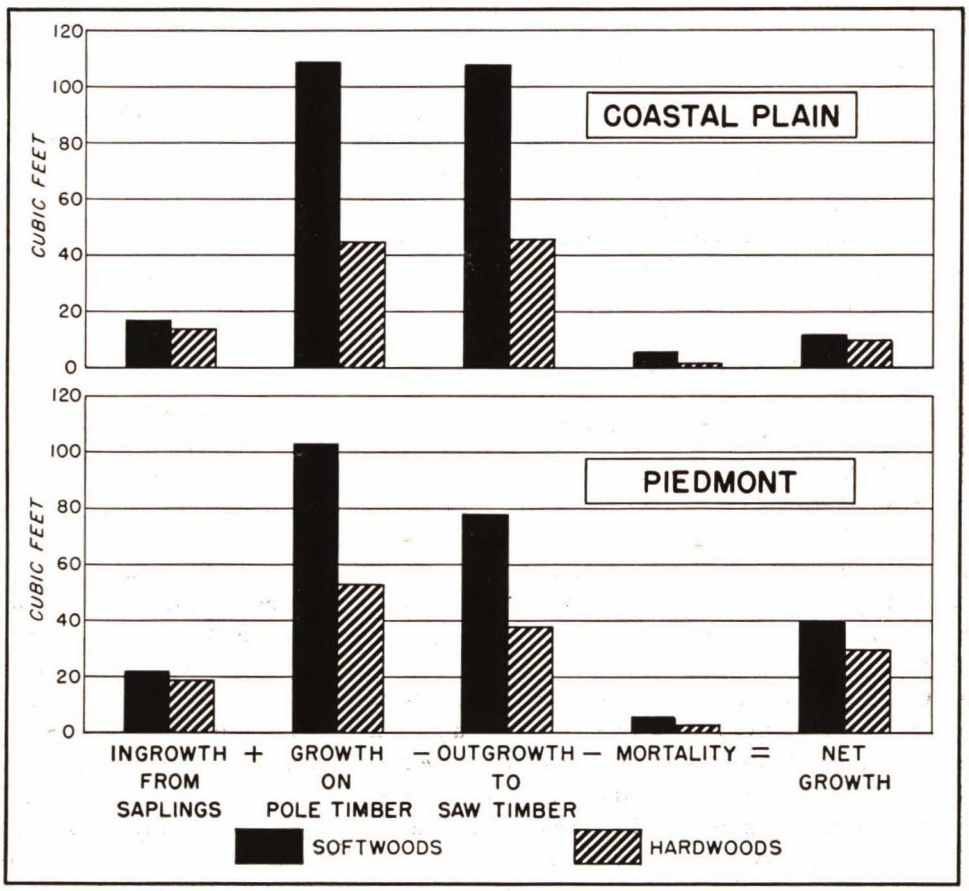

FIGURE 45. — *Components of net pole-timber growth, in terms of cubic feet per thousand cubic feet of pole-timber growing stock, 1946.*

to saw timber. Saplings in the Coastal Plain contribute less to ingrowth because so many of the small trees occur as a dense understory in older stands, where they grow very slowly. Thus, the value of a large backlog of young timber is greatly diminished if a large part of it continues to grow very slowly under adverse competitive conditions in the stand. In such instances, thinning and stand improvement will help to increase pole-timber growth.

Differences in outgrowth account for most of the difference in net pole-timber growth between the Coastal Plain and the Piedmont. This large outgrowth in the Coastal Plain does not mean any less total growth: it merely means that the greater proportion of the pole-timber growth appears as saw timber. Balancing growth and drain means a shift of drain from pole-timber sizes to saw-timber sizes. But if this shift cannot be made or is not made, pole-timber growing stock will continue to decline. Both net pole-timber growth and saw-timber growth are affected. For instance, the effect of a shortage of pole-timber growing stock in the Coastal Plain is already in evidence. Even though outgrowth rates are higher here, pole timber contributes only 25 percent of the total saw-timber growth in board feet. In the Piedmont 34 percent of the saw-timber growth comes from the pole-timber growing stock.

An adequate supply of saw timber requires an adequate supply of pole timber. Thus, pole timber is the keystone in the future timber-supply structure. In short, the picture is this: In the Piedmont, pole timber, which is already abundant, is increasing very rapidly and is not being cut very heavily. The opposite is true in the Coastal Plain: pole timber, already in short supply, is being cut very heavily and continues to decline.

Drain Differs by Locality

The tremendous variation in the intensity of commodity drain between local areas constitutes a distinctive feature of the drain pattern in South Carolina. In 1946, for instance, softwood drain by county ranged from 22 cords per thousand cords of growing stock to 264 cords (fig. 46). The intensity of cutting in some local areas partially reflects the manner in which the old-growth forests were cut. Vast areas of timberland were cut over in a relatively short time; the second-growth forests which followed were approximately of one age. Also, successive waves of cropland abandonment, especially in the Piedmont, resulted in many even-aged stands all falling within two or three age classes.

Consequently, in many localities, a large part of the second-growth timber reaches merchantable size at about the same time. Soon thereafter, numerous small sawmills spring up throughout the countryside, and drain in these local areas is greatly increased. There is usually not enough timber, however, to support this high concentration of sawmills and within a few years many shut down or move on to areas with a better supply. This is evident from what took place in the period 1942-47. During those 6 years, lumber production in counties such as Horry, Williamsburg, and Marion dropped as much as 50 percent in proportion to the State total, and the industry has moved southward into the area centering around Dorchester County (fig. 47). There has been a similar shift in production from the lower to the upper Piedmont.

In the past, this shifting of cutting intensity by local areas tended to be self-perpetuating. As large areas of timberland were cut over in a relatively short time, the stands which followed retained their even-age character. However, in spite of extremely heavy cutting locally, the present trend is toward a greater number of age classes. The shift is from pure pine stands to mixed pine-hardwood stands which inherently take on a many-aged character. Further, pulpwood cutting operations, which do not tend to concentrate in local areas as much as sawmill operations, can be expected to reduce some of the fluctuations in drain by creating a greater variety of stand size. Finally, the increase in forest land ownership by forest industries will serve as a stabilizing influence on local drain as these areas are put under sustained-yield management.

No Reduction in Drain in Sight

Future drain can be expected to fluctuate with changes in economic activity and accompanying price changes. For example, in 1923, during a period of high economic activity, softwood lumber production hit a peak of over a billion board feet, then dropped to less than 400 million during the depression years of the early 30's. In 1932, when the average mill price of yellow pine lumber in South Carolina was $4.66 per thousand less than in 1931, production dropped 45 million board feet (fig. 48). On the other hand, in 1936, when the price was $20.30 per thousand, or $3.14 more than the preceding year, lumber production increased 97 million board feet (*11*). In like manner, production increased sharply in 1941 and 1942, and in 1946. As long as economic activity remains at the present high level a reduction in lumber drain seems very unlikely.

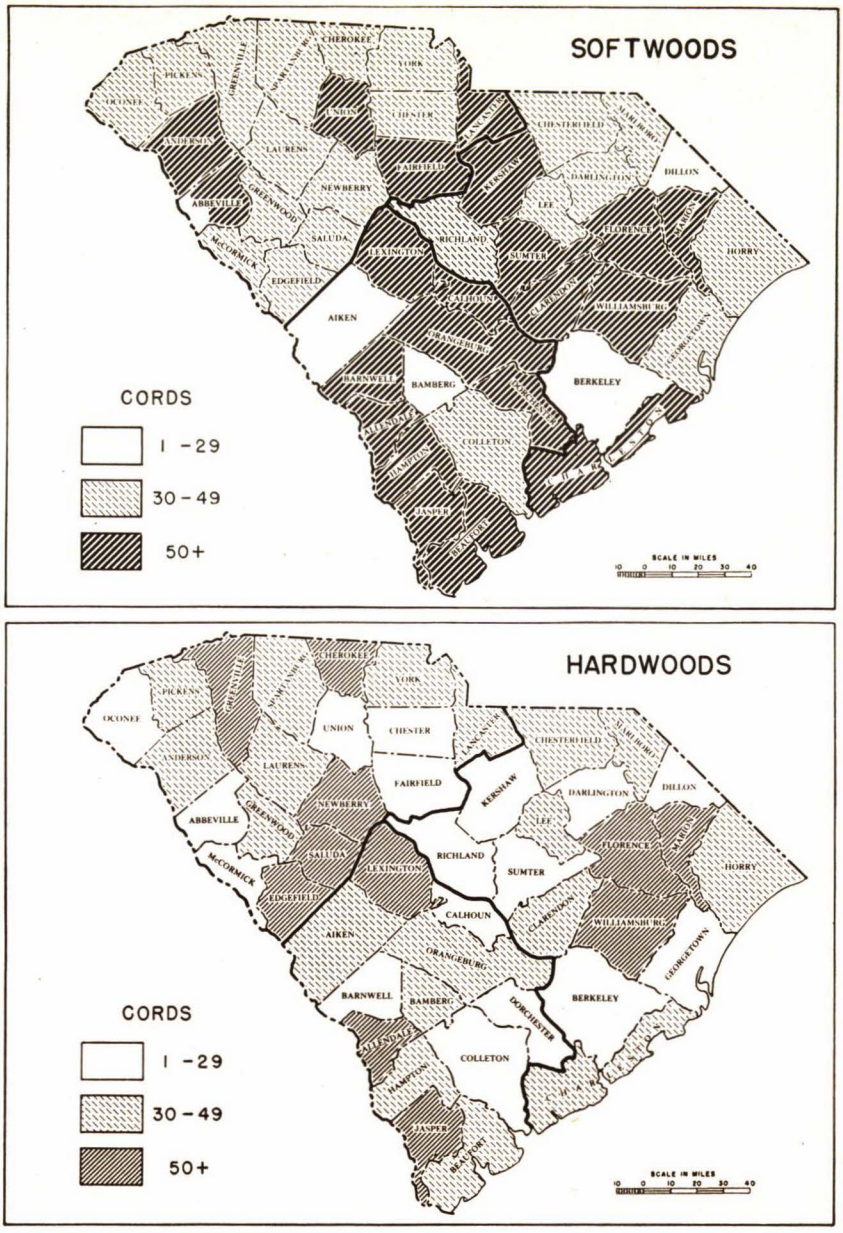

FIGURE 46. — *Cords of commodity drain per 1,000 cords of growing stock in trees 5.0 inches d.b.h. and larger, 1946.*

Pulpwood drain has been steadily increasing since 1936. The two large pulp mills at Georgetown and Charleston have increased their capacity in recent years as have most of the mills in adjoining States which draw wood from South Carolina. In 1948 another large pulp mill started operating at Savannah, Ga., adding further to the drain on South Carolina's timber. Recent announcements indicate a new mill to use hardwoods for dissolving pulp will be built at Charleston. Thus, all the evidence points toward a continued high level of pulpwood drain.

Fuel wood ranks with pulpwood as an item of drain, although more than half of it is cut from hardwoods. Fuel-wood production for home consumption is not greatly affected by fluctuations in economic conditions; if anything, it tends to decrease during boom times, as labor is relatively expensive then, and in many instances, it is cheaper to use oil for home heating. Large amounts of fuel wood are also used for tobacco curing in the northeastern part of the Coastal Plain. The prospect of continued high tobacco acreages, encouraged by price supports, promises to put a high floor under future

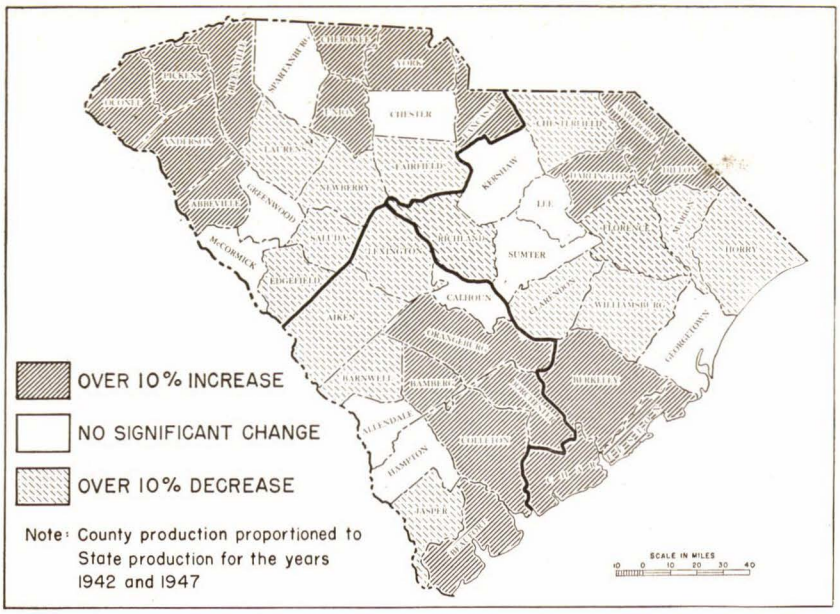
OVER 10% INCREASE
NO SIGNIFICANT CHANGE
OVER 10% DECREASE
Note: County production proportioned to State production for the years 1942 and 1947
SCALE IN MILES
10 0 10 20 30 40

FIGURE 47. — *Geographic shifts in lumber production, 1942 to 1947.*

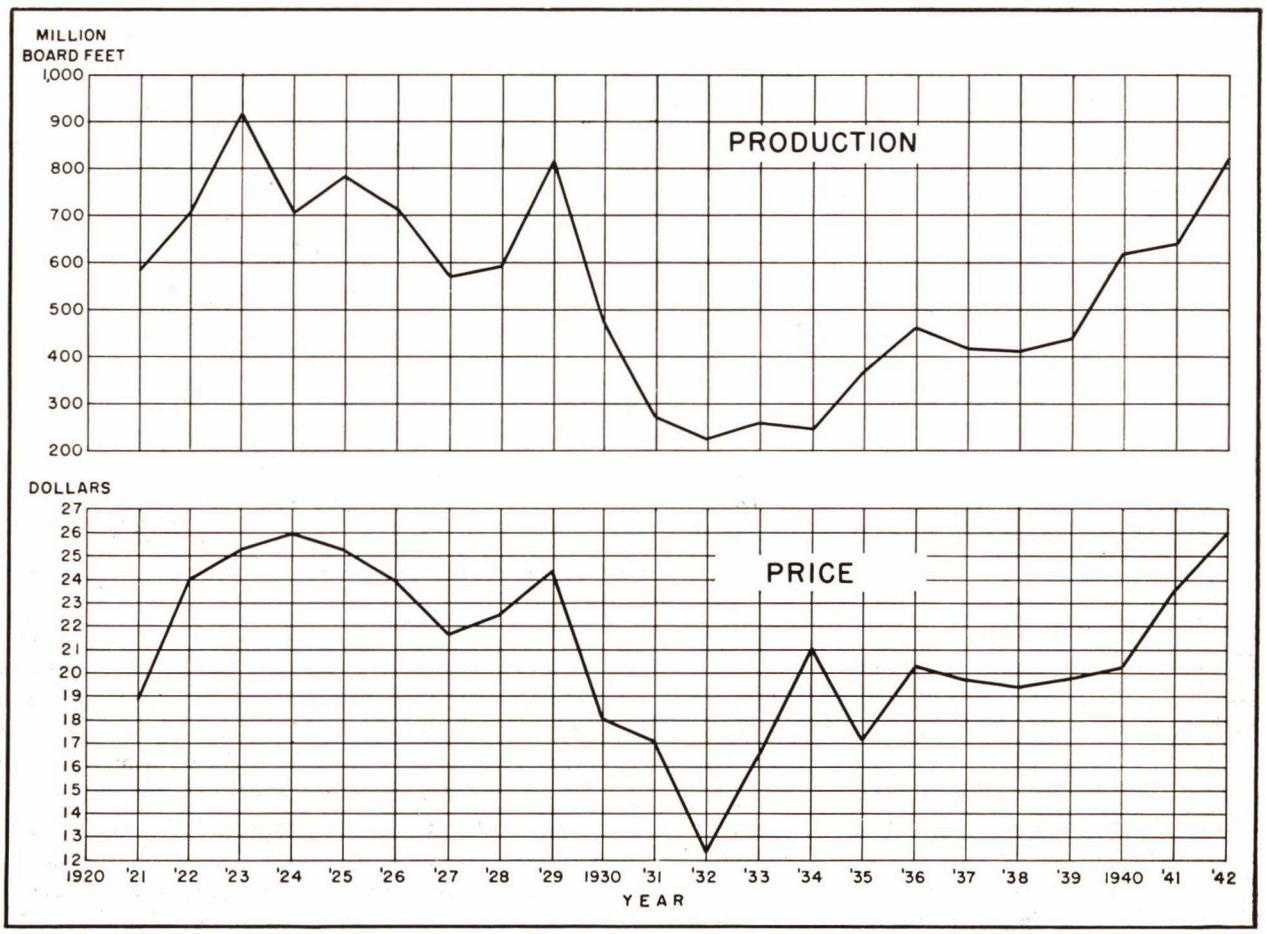

FIGURE 48. — *Average price and production of yellow pine lumber in South Carolina, 1921-42.*

FIGURE 49. — *Improved fire protection has helped to reduce timber losses in South Carolina.*

fuel-wood drain in this tobacco-growing section. As with domestic fuel wood, however, there is a tendency to substitute oil for wood when tobacco prices are high. In all probability the total amount of fuel wood produced will not drop much below the 1946 level, but it should be possible to reduce gradually the drain on sound trees and obtain a larger part from cull trees and mill waste.

State-wide improvement in fire protection (fig. 49), the virtual cessation of turpentining, and the removal of most of the overmature timber have helped to reduce mortality losses. In 1946, saw-timber mortality from fire, insects, littleleaf, and other natural causes was 230 million board feet less than in 1936. Intensification of fire protection activities and increased efforts to salvage diseased timber will reduce mortality to some extent, but at its present low level further substantial reductions cannot be expected.

Forest Industries and the Timber Supply

DRAIN on the forest is not only influenced by changes in economic conditions, but also by the make-up and character of the State's forest industries. The kind and location of the industries, their size and number, the species, size, and quality of the timber they use, all have an important effect upon the amount of drain and its effect on forest productivity. Overcutting of certain species and sizes, sharp differences in drain by locality, understocking, low timber quality, and shortages of certain sizes are often closely related to the nature of the forest industries and their associated drain pattern. For example, the recent development of the pulp and paper industry in South Carolina and adjoining States increased drain on pole timber to the extent that growth is no longer sufficient to balance drain on this class of timber.

LUMBER BIGGEST ITEM OF DRAIN

Sawlogs for lumber production are the largest single item of drain in South Carolina. In 1946, they amounted to half the total drain on trees 5.0 inches and larger and two-thirds of the total saw-timber drain (fig. 50). In spite of the recent expansion in nonlumber uses of wood, notably pulpwood, sawlog drain has kept pace with the general rise in total drain. In 1936 as in 1946, it made up 50 percent of the total drain.

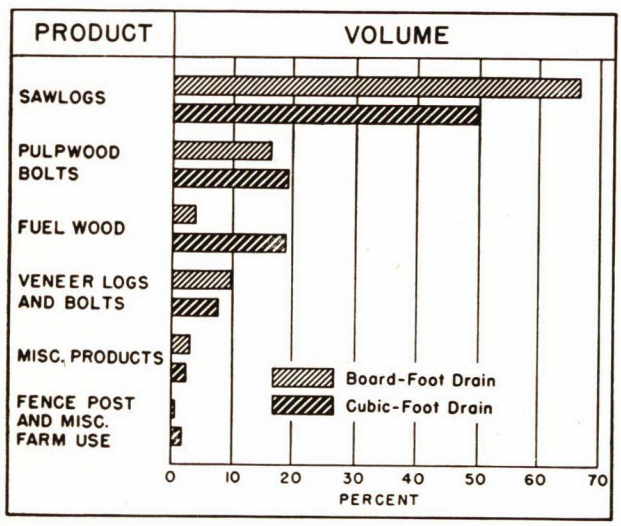

FIGURE 50. — *Percent distribution of commodity drain, by product, 1946.*

Small Sawmills Cut Three-fourths of Lumber

No institution is more typically a product of second-growth forests than the small sawmill. The rise of the small portable mill and the decline of the large permanent types shows what sweeping changes in a forest industry can be caused by change in the nature of the timber supply. The large band mills, which were dominant in South Carolina in the early 1900's, were dependent upon heavy concentrations of virgin timber. By 1925, most of this timber was exhausted and the large mills were gradually replaced by small portable plants (fig. 51) especially adapted to operating small lightly stocked stands of second-growth timber. When the timber becomes too scarce in a certain locality, the small mill operator can either shut down or move on to other timbered areas. Likewise, when lumber prices are not to his liking, he can put his equipment in storage and not worry too much about fixed charges and depreciation. Conversely, when lumber prices are high, these idle mills can quickly come back into production. A widely scattered supply of poor-quality timber, the uncertainty of how long the supply will last, and vicissitude of lumber prices — all these operate to the distinct disadvantage of large permanent mills with heavy initial capital investment and high fixed charges. Currently and in the foreseeable future, small sawmills reign supreme in the second-growth forests of South Carolina (fig. 52).

They have a significant effect upon the future timber supply, inasmuch as their cutting and utilization practices are typically poor.

Eighty percent of the mills reporting lumber production in 1946 cut, on the average, only 247 thousand board feet per year, yet their cut in the aggregate added up to 31 percent of the total lumber production in the State (table 10).

FIGURE 51. — *Three-fourths of the lumber produced in South Carolina is sawed by mills of this general type.*

The 272 mills which each averaged around a million-and-a-half board feet in 1946 represent a more stable element in the lumber industry (fig. 53). Owners of these mills are in the sawmill business; sawmilling is usually their chief source of income. While often in the transient class, these operations are better financed, better equipped, operate more steadily, and produce a better quality product.

Concentration yards (fig. 54) are an important adjunct to the small-mill business. There are about 80 of these in the State. A typical yard is equipped with a planer, sometimes a dry kiln, and frequently a small sawmill. Rough green lumber is obtained from a number of tributary small sawmills within short trucking distance. At the concentration yard the lumber is graded, dried, dressed, and marketed in car and truck-load quantities. Some of the tributary mills are owned by the yard operator. In other cases the concentrator buys stumpage and contracts the logging and sawing. In still other instances lumber is purchased from independent mills in competition with other buyers. In addition to providing a local market for small quantities of mill-run lumber, the yard operator sometimes helps the small sawmiller by providing working capital for payrolls and stumpage.

TABLE 10. — *Lumber production, by size of mill, 1946*[1]

Range of annual production (M bd. ft.)	Sawmills		Production	
	Number	*Percent*	*Million bd. ft.*	*Percent*
1—999	1,271	80	313.9	31
1,000—2,999	272	17	417.9	42
3,000—9,999	33	2	170.1	17
10,000+	7	1	98.9	10
All classes	1,583	100	1,000.8	100

[1] Data obtained in cooperation with Bureau of the Census.

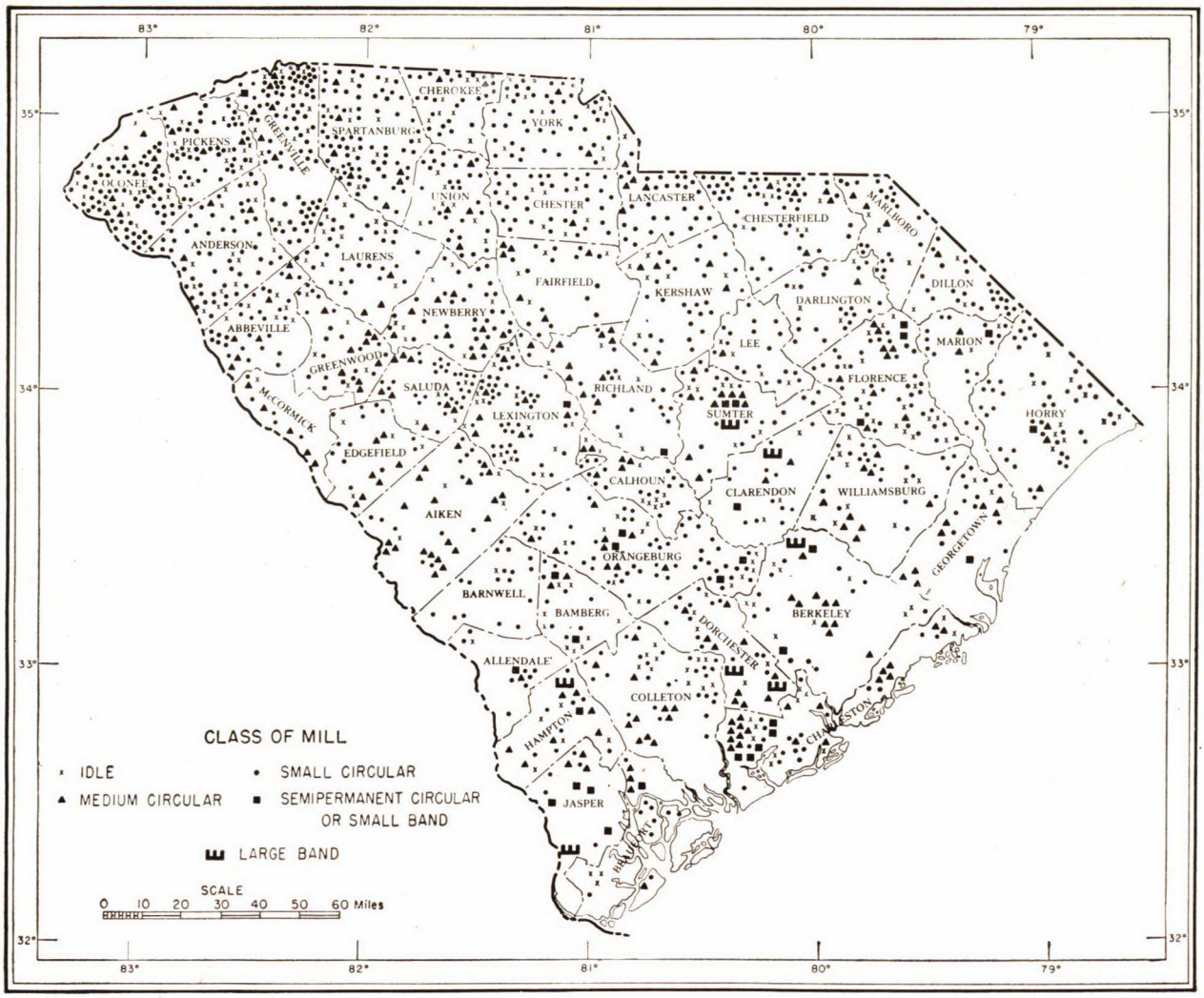

FIGURE 52. — *Small sawmills operate in every county, but are more numerous in the Piedmont (data obtained in cooperation with the Bureau of the Census).*

Number of Sawmills Doubled Since 1936

South Carolina had more than twice as many sawmills in 1946 as in 1936. The number of mills cutting less than a million board feet per year has increased 37 percent since 1942, while the number cutting a million or more has decreased (table 11). Six mills sawing over 5 million feet per year stopped operating between 1942 and 1946, leaving only 20 of these large mills in the State.

The effect has been a lower average production per mill, with each mill accounting for a smaller share of the drain on the forest. This tendency is most marked

TABLE 11. — *Number of active sawmills, by size class and region, 1942 and 1946* [1]

Range of annual production (M bd. ft.)	Southern Coastal Plain		Northern Coastal Plain		Piedmont		State	
	1942	1946	1942	1946	1942	1946	1942	1946
1—999	163	227	274	383	490	661	927	1,271
1,000—4,999	80	89	139	109	95	94	314	292
5,000+	10	11	14	8	2	1	26	20
All classes	253	327	427	500	587	756	1,267	1,583

[1] Data obtained in cooperation with Bureau of the Census.

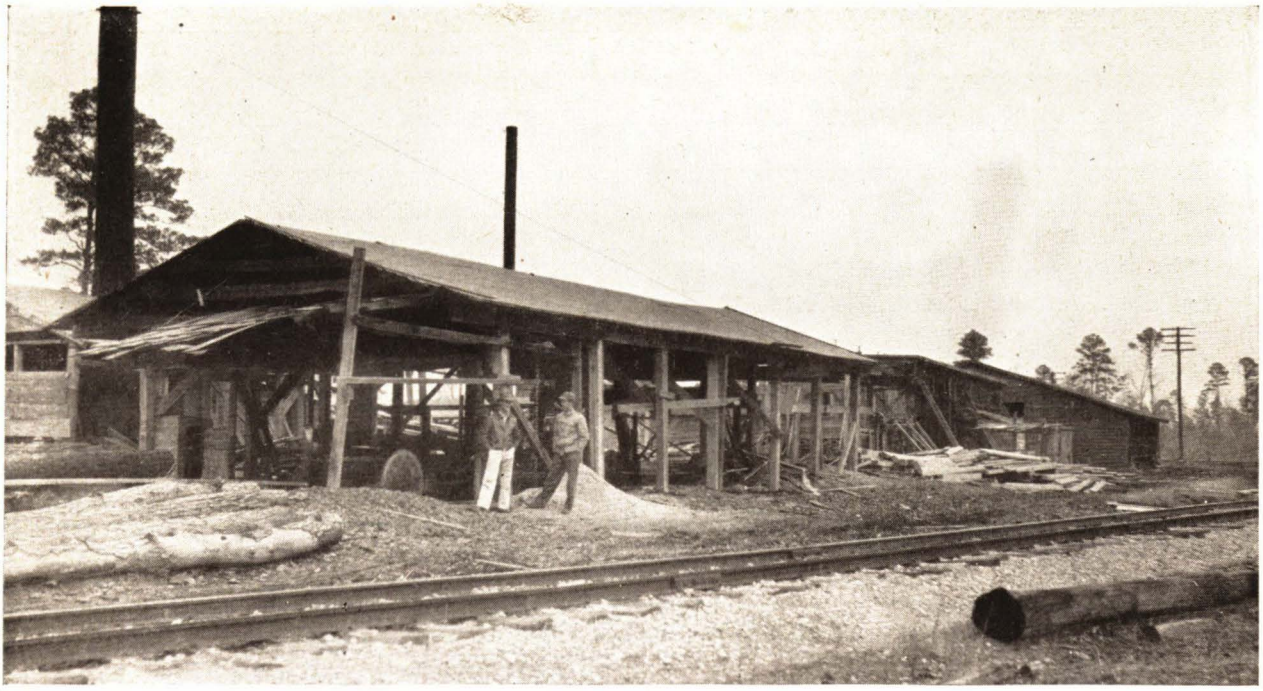

FIGURE 53. — *The medium-sized stationary circular mills are better equipped and operate more regularly.*

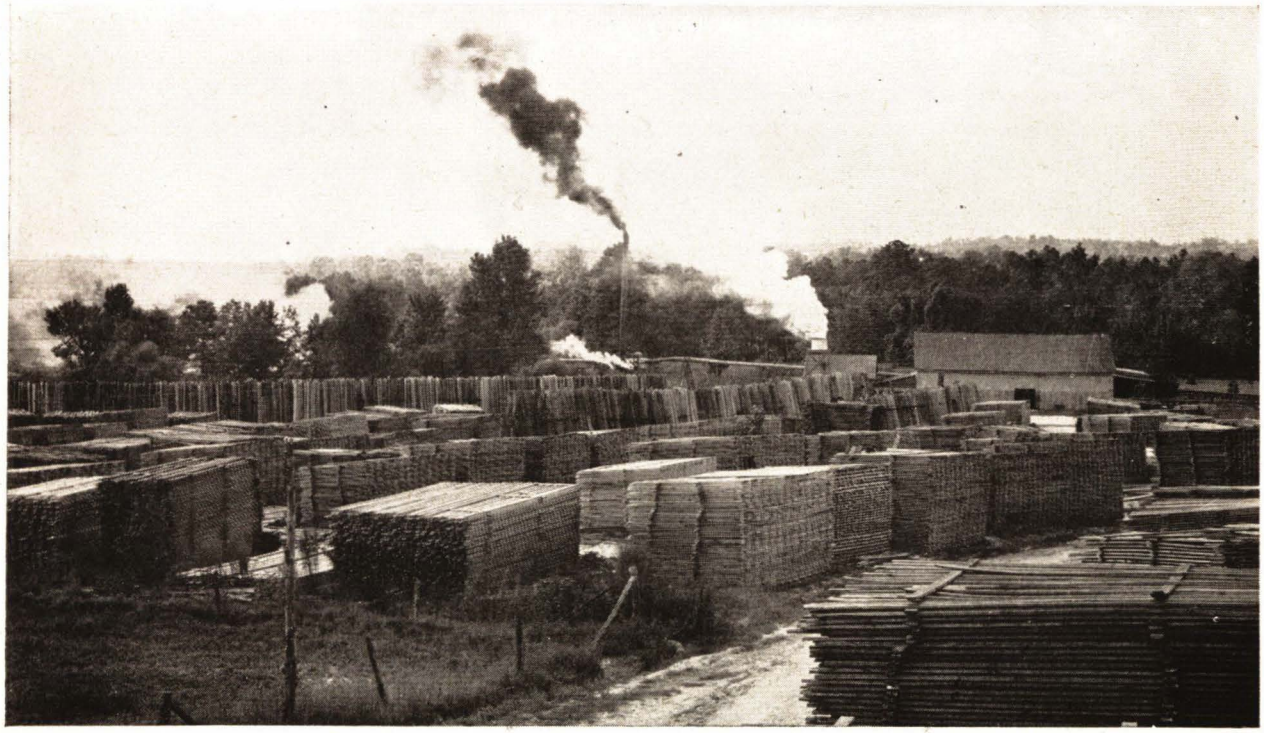

FIGURE 54. — *Rough green lumber is brought in from a number of small sawmills to central concentration yards.*

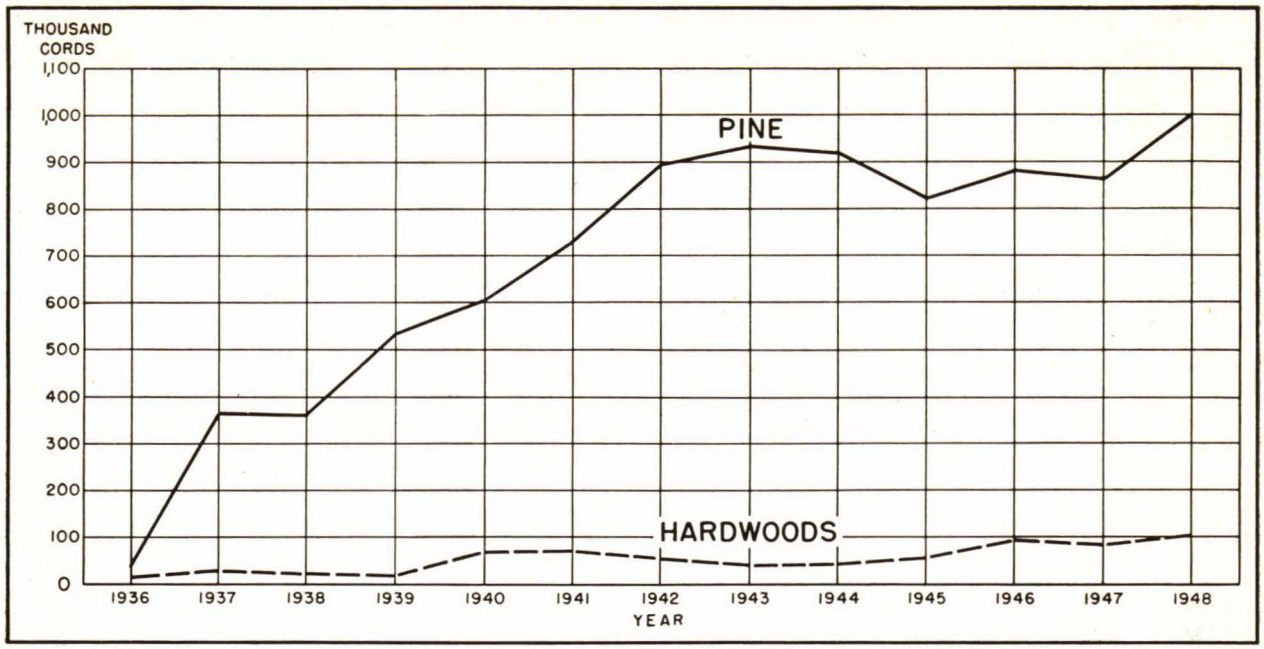

FIGURE 55. — *Pulpwood drain in South Carolina, by species group, 1936-48.*

in the Coastal Plain, as indicated in the following tabulation:

Region:	*Average sawlog drain per operating sawmill* [1]		
	1936 (M bd. ft.)	*1942 (M bd. ft.)*	*1946 (M bd. ft.)*
Coastal Plain	1,567	1,206	864
Piedmont	422	439	396
South Carolina	1,026	851	641

[1] Data obtained in cooperation with Bureau of the Census.

ANNUAL PULPWOOD CUT NEARLY A MILLION CORDS

The rise of the pulp and paper industry in South Carolina since 1937 represents a major development in the commodity drain picture. Prior to 1937 one small pulp mill, the Carolina Fibre Company mill at Hartsville, producing corrugated board and wrapping paper from black gum, accounted for practically all the pulp-

FIGURE 56.—*Most of the pulpwood in South Carolina is cut by the employees of producers who sell through dealers.*

wood drain on the forests in the State. Little pulpwood was cut in South Carolina to supply mills in adjoining States.

With the completion of two new mills in 1937 — the West Virginia Pulp and Paper Company mill at Charleston and the International Paper Company mill at Georgetown — pulping capacity per 24 hours jumped from 100 tons to over 1,000 tons. Subsequent expansion of these two plants more than doubled pulping capacity so that the total in the State in 1949 was 2,184 tons of pulp per 24 hours (*4*). In addition, out-of-State mills drawing part of their pulpwood from South Carolina now have a daily capacity of 3,170 tons.

This growth in the pulp and paper industry in South Carolina and adjoining States meant a rise in pulpwood drain from 49,000 cords in 1936 to a current drain of around a million cords a year (fig. 55). The 980,000 cords (*5*) of pulpwood drain in 1946 represented 20 percent of the total drain in the State, 70 percent from sawlog-size trees and the remainder from pole timber.

The pulp and paper industry represents a more stable element in the drain outlook in South Carolina than the lumber industry. Production, of course, still fluctuates with changing prices in paper products. With present mills operating at capacity it is possible to predict a pulpwood drain of around a million cords a year unless there is a significant change in the wood-procurement pattern of the industry.

Pulpwood is produced under a dealer-producer arrangement which in some respects resembles the arrangement between concentration yards and sawmill operators (fig. 56). The areas from which the pulp

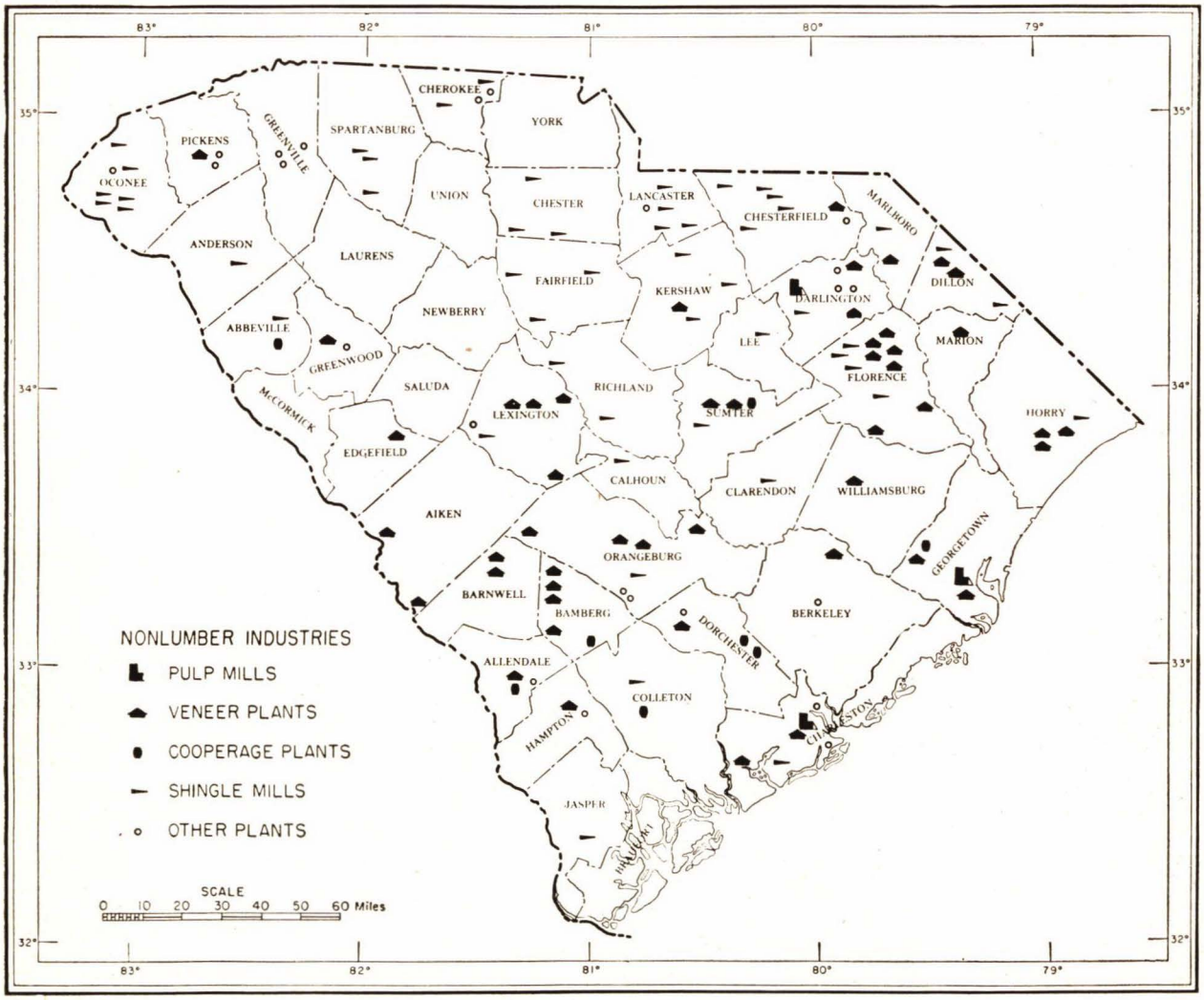

FIGURE 57. — *Location of veneer plants, pulp mills, and other primary nonlumber forest plants, 1946.*

companies obtain their pulpwood supplies are divided into procurement areas or dealerships ranging in size from part of a county to several counties, depending upon the amount of timber available in the area and distance from the mill. Each dealer is assigned a monthly or weekly quota of pulpwood to be produced from his area. In filling this quota, he assigns quotas to a number of independent producers. Like the yard operator in assisting the sawmill operator, the dealer often assists the producer by advancing him money and lining up stumpage. Thus, both the concentration yard and dealership arrangements help to solve many of the financial and organization problems of small operators.

Other Forest Products Industries

Fifth of Drain is Timber Cut for Fuel Wood

Equal to pulpwood as an item of drain on the forests, fuel wood accounted for a fifth of the total drain in South Carolina in 1946. Two-thirds of the fuel-wood drain is cut from hardwoods, most of them of pole size. Fuel wood makes up only about 4 percent of the total board-foot drain.

Fuel-wood drain is associated to a considerable degree with the tobacco-growing industry, which is concentrated in the northern part of the Coastal Plain. The 1946 tobacco acreage in South Carolina was among the highest since 1920, exceeded only slightly by the acreage in 1928 (*9*). Tobacco harvested in Horry County, for instance, jumped from 29,000 acres in 1945 to 34,000 in 1946. Furthermore, the 1946 average yield per acre set a new record for the State (*2*). This meant a record tobacco crop to be cured and a large part of it was cured with fuel wood cut from hard hardwood pole timber.

Fuel wood is produced for domestic heating and cooking throughout every county. In recent years less wood has been cut from sound pine trees and a greater proportion has been obtained from slabs and other mill waste. This has contributed to reducing the total fuel-wood drain in the State from 1.4 million cords in 1936 to 1.0 million cords in 1946.

Veneer Industry Cuts 100 Million Board Feet Annually

The increase in number of veneer mills from 25 in 1936 to 48 in 1946 (fig. 57) has not been accompanied by a comparable increase in veneer log drain. Between 1936 and 1945, timber cut for veneer logs averaged about 100 million board feet a year. In 1946, however, veneer log drain increased to 150 million board feet, which may herald an upward trend.

Two industries are dependent upon the veneer plants for raw material — the furniture industry and the container industry. High-grade face veneers and lower grades, cut mainly from sweetgum, black gum, and yellow-poplar, are used by the furniture factories in South Carolina and those in the highly developed furniture

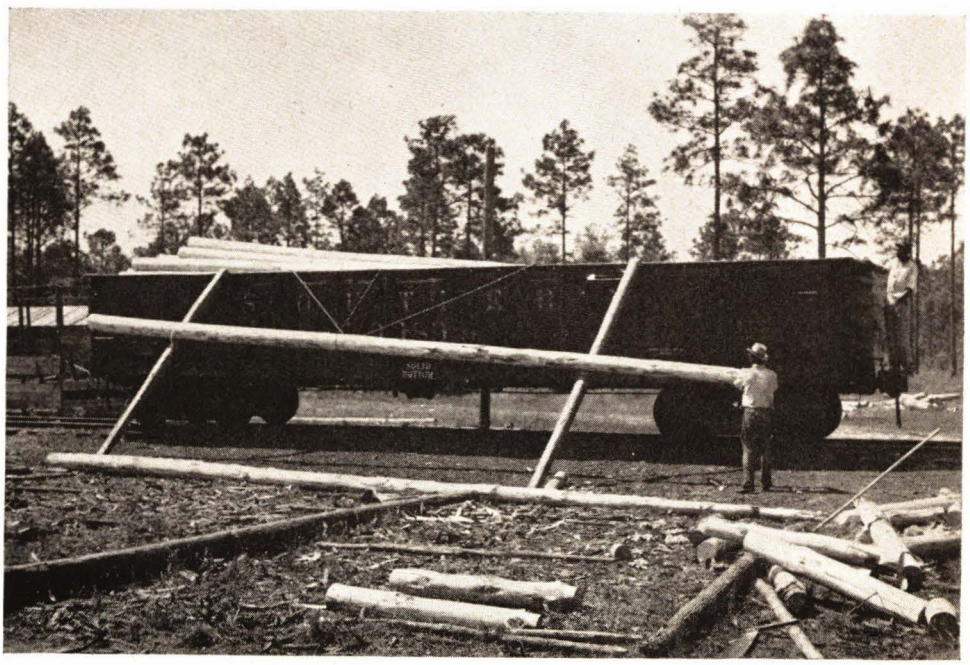

FIGURE 58. — *Poles add to the great variety of timber products cut from the forests of South Carolina.*

industry in North Carolina. Both hardwood and second-growth pine veneers are used for the manufacture of crates and baskets for sale to the fruit and vegetable shippers in South Carolina and the adjoining States.

As a result of the gradual depletion of the old-growth lowland hardwoods of the Coastal Plain, the veneer industry has lowered its specifications to include bolts of smaller diameters and poorer quality. While old growth still provides the greater part of the raw material, more and more veneer is being produced from second-growth hardwoods growing on the upland sites.

Miscellaneous Industries

The remaining forest products industries in South Carolina, including those turning out cooperage bolts, poles, piling, posts, mine timbers, hewn cross ties, and shingles, account for only 4.5 percent of the total commodity drain on the forests (fig. 58). In spite of a general increase in the number of operations since 1936, the drain of these miscellaneous industries was only 228,000 cords in 1946 compared to 341,000 cords in 1936. In 1936, there were 34 miscellaneous wood-using plants, and in 1946, 82 plants, further emphasizing the swing toward more and smaller enterprises.

How Much Timber Is Needed

HOW MUCH timber does South Carolina need to grow? A minimum objective is to grow enough to meet the requirements, in quantity and quality, of the present forest industries. A more foresighted goal is to grow not only enough timber to satisfy present need, but also enough to support some industrial expansion, and to provide a margin for security against abnormal insect, disease, and fire losses, and national emergencies such as war.

To meet timber needs indicated in 1946, total annual growth of sound timber would have to be increased 11 percent, from 5.6 to 6.2 million cords. To reach the second objective, which is the goal used in this report, total annual growth of all timber should be increased to an estimated 6.9 million cords, or 23 percent more than was grown in 1946 (fig. 59). This approximates South Carolina's share of the national growth goal as estimated by the U. S. Forest Service (*15*).

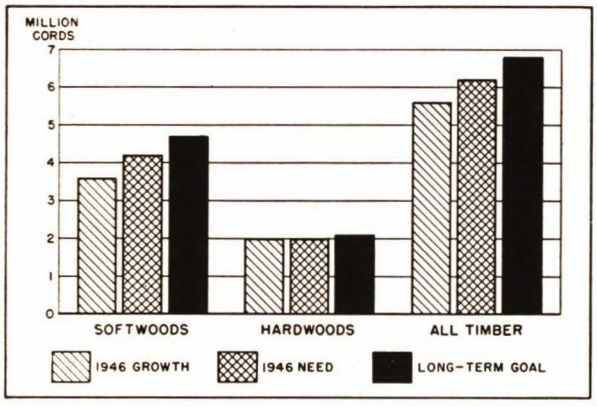

FIGURE 59. — *Growth in 1946, growth needed to meet 1946 timber needs, and growth goals, by species group.*

The amount of timber that must be grown varies considerably by species, and even by locality within the State (table 12). For instance, all timber growth goals for the softwoods call for an increase of 31 percent compared to 7 percent in the hardwoods. In the Piedmont the softwood growth goal is only 14 percent more than 1946 growth, in contrast to the southern Coastal Plain, where the goal is 51 percent above current yields.

TABLE 12. — *All timber growth goals and 1946 growth, by region and species group*

Region	Softwoods		Hardwoods		All species	
	Growth goal	1946 growth	Growth goal	1946 growth	Growth goal	1946 growth
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*
Southern Coastal Plain	1,194	791	592	544	1,786	1,335
Northern Coastal Plain	1,930	1,408	903	851	2,833	2,259
Piedmont	1,622	1,427	611	568	2,233	1,995
South Carolina	4,746	3,626	2,106	1,963	6,852	5,589

Both timber-producing potentiality and current drain intensity were considered in setting growth goals in various parts of the State. Throughout, growth goals were set sufficiently high to meet current drain. The northern Coastal Plain, because of its high growth possibilities, should contribute an increasing share of the growth.

INCREASE OF 28 PERCENT IN SAW-TIMBER GROWTH NEEDED

In 1946, saw-timber drain exceeded growth by 4 percent. To meet anticipated as well as current needs, it is estimated that South Carolina should plan to grow 1,865 million board feet a year compared with 1946 growth of 1,457 million board feet (table 13). This would mean increasing this growth by 28 percent.

Softwood growth must be increased by 40 percent, while a 6-percent increase in the hardwood species would be sufficient. Increases in hardwood growth should be confined entirely to gums, soft maple, and yellow-poplar, where the disparity between growth and drain is almost as great as in the softwoods.

SAW-TIMBER GROWTH GOALS DEPEND UPON POLE TIMBER

Pole-timber growth goals, as calculated in this report, represent the net annual increase in pole-timber grow-

TABLE 13. — *Saw-timber growth goals and 1946 growth, by region and species groups*

Region	Softwoods		Hardwoods		All species	
	Growth goal	1946 growth	Growth goal	1946 growth	Growth goal	1946 growth
	Million bd. ft.	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*	*Million bd. ft.*
Southern Coastal Plain	350	232	178	167	528	399
Northern Coastal Plain	614	454	255	255	869	709
Piedmont	340	244	128	105	468	349
South Carolina	1,304	930	561	527	1,865	1,457

ing stock needed to sustain the saw-timber growth goals. The saw-timber growth goal has been set high enough so that a large volume of pole-size timber now being cut can in the future be cut as saw timber. In other words, increasing the rotation age (shifting pole-timber drain to saw-timber drain) represents a practical and feasible method of increasing total forest production. Ultimately, when growing stock is properly distributed in the forest — and providing there are no significant changes in growth rates — total pole-timber growth will be 11 percent below 1946 growth (table 14).

This shift of pole-timber drain to saw-timber sizes is practical for most commodities now cut from pole timber. For instance, small saw-timber trees are well suited for pulpwood bolts. In 1946, 70 percent of the total pulpwood drain came from saw timber. In fact, there is evidence (*1*) that pulpwood cut from 12-inch trees yields greater margins for stumpage than that from other tree sizes. Neither do fuel-wood specifications confine the cut to pole timber. The majority of the poles and piling are now cut from small saw timber rather than from pole-size trees. Only fence posts, which in 1946 comprised one percent of the total drain, are cut mainly from pole timber out of preference for this size. Consequently, there are few timber needs which must be met exclusively from pole-size trees.

The proposed reduction in pole-timber growth is entirely in the Piedmont, where a surplus exists at present. This does not mean any reduction in total growth of all sizes of timber; actually it means an increase. It means that a large part of the forest area now supporting pole timber will eventually support saw timber. It means that where the trees are now cut when they are 6 or 8 inches in diameter, they will be allowed to grow to 10 or 12 inches before they are cut. The result will be a higher cubic-foot growth per acre as well as a fuller utilization of the timber-growing capabilities of the forest land.

In the Coastal Plain, where a deficiency now exists, pole-timber growth goals are substantially above current growth and are established at a level that will sustain the required saw-timber growing stock. They will not, however, equal even the 1946 drain on pole timber, which amounted to 787,000 cords. Temporarily, some of this drain may come from the Piedmont, where there is a surplus of pole timber. Ultimately, however, if pole-timber growing stock is to be maintained, this excess drain over growth must come from sawlog-size trees. Again it simply means, as in the Piedmont, increasing the rotation age of the timber.

TABLE 14. — *Pole-timber growth goals and 1946 growth, by region and species group*

Region	Softwoods		Hardwoods		All species	
	Growth goal	1946 growth	Growth goal	1946 growth	Growth goal	1946 growth
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*
Southern Coastal Plain	70	46	51	36	121	82
Northern Coastal Plain	106	59	181	129	287	188
Piedmont	215	418	174	210	389	628
South Carolina	391	523	406	375	797	898

TWENTY-FOUR PERCENT INCREASE IN GROWING STOCK NEEDED

One of the best ways to increase growth is through increasing the quantity of growing stock. Assuming 1946 growth rates, the growing stock volume of all sound trees 5.0 inches d.b.h. and larger must be increased from 120 million cords to 149 million cords to meet prospective timber needs (growth goals), or an increase of 24 percent (table 15). Most of the increase is needed in the softwood species; growing stock requirements call for a 34-percent increase compared to a 12-percent increase in hardwoods. Practically all the increase in hardwoods should be confined to the soft hardwood species such as the gums and yellow-poplar. It is mainly in these that growth is lagging behind current needs.

To achieve saw-timber growth goals at current growth rates, saw-timber growing stock must be increased substantially in all parts of the State (table 16). The

TABLE 15. — *Present growing stock and the amount required to meet growth goals, by region and species group*[1]

Region	Softwoods		Hardwoods		All species	
	Present	Required	Present	Required	Present	Required
	Million cords	*Million cords*	*Million cords*	*Million cords*	*Million cords*	*Million cords*
Southern Coastal Plain	15.5	23.9	14.4	17.1	29.9	41.0
Northern Coastal Plain	28.6	41.1	26.9	30.8	55.5	71.9
Piedmont	21.9	23.4	12.8	12.9	34.7	36.3
South Carolina	66.0	88.4	54.1	60.8	120.1	149.2

[1] All sound trees 5.0 inches d.b.h. and larger.

increase in the Coastal Plain would be confined almost entirely to the softwood species, but in the Piedmont both softwoods and hardwoods must be increased. Even though the bulk of the saw timber would still be in the Coastal Plain, the largest proportionate increase is proposed for the Piedmont, where the exceedingly low supply of saw timber must be increased by 48 percent — softwoods by 62 percent and hardwoods by 23 percent.

TABLE 16. — *Present saw-timber growing stock and the amount required to meet growth goals, by region and species group*

Region	Softwoods		Hardwoods		All species	
	Present	Required	Present	Required	Present	Required
	Billion bd. ft.	*Billion bd. ft.*	*Billion bd. ft.*	*Billion bd. ft.*	*Billion bd. ft.*	*Billion bd. ft.*
Southern Coastal Plain	4.5	6.9	3.3	3.5	7.8	10.4
Northern Coastal Plain	8.9	12.0	6.4	6.4	15.3	18.4
Piedmont	4.2	6.8	2.2	2.7	6.4	9.5
South Carolina	17.6	25.7	11.9	12.6	29.5	38.3

Once the saw-timber growing stock has been built up to the desired level, only one-half the present volume of softwood pole timber in the Piedmont would be needed to meet growth goals (table 17). However, part of this present surplus is needed to build up saw-timber growing stock. On the other hand, a 54-percent increase in softwood pole-timber growing stock is called for in the southern Coastal Plain, and 78 percent in the northern Coastal Plain. Hardwood growing stock of this size timber must be increased by 40 percent for the Coastal Plain, but there is 20 percent more than is required in the Piedmont.

TABLE 17. — *Present pole-timber growing stock and the amount required to meet growth goals, by region and species group*

Region	Softwoods		Hardwoods		All species	
	Present	Required	Present	Required	Present	Required
	Million cords	*Million cords*	*Million cords*	*Million cords*	*Million cords*	*Million cords*
Southern Coastal Plain	3.7	5.7	5.7	7.9	9.4	13.6
Northern Coastal Plain	5.5	9.8	10.2	14.3	15.7	24.1
Piedmont	10.9	5.6	7.2	6.0	18.1	11.6
South Carolina	20.1	21.1	23.1	28.2	43.2	49.3

For the State as a whole, the supply of both softwood and hardwood sapling growing stock is adequate to provide a balanced distribution of growing stock. However, serious shortages of softwood saplings are disclosed in the Coastal Plain (table 18). A proper balance of growing stock requires an increase in softwood sapling growing stock of 57 percent in the southern part of the Coastal Plain and 68 percent in the northern part. Substantial surpluses of hardwood saplings are found throughout the Coastal Plain, while all species of saplings are in excess of requirements in the Piedmont.

TABLE 18. — *Present sapling basal area and the amount required to meet growth goals, by region and species group*

Region	Softwoods		Hardwoods		All species	
	Present	Required	Present	Required	Present	Required
	Million sq. ft.	*Million sq. ft.*	*Million sq. ft.*	*Million sq. ft.*	*Million sq. ft.*	*Million sq. ft.*
Southern Coastal Plain	7.4	11.6	13.2	9.1	20.6	20.7
Northern Coastal Plain	12.0	20.1	26.1	16.5	38.1	36.6
Piedmont	33.4	11.4	25.8	6.9	59.2	18.3
South Carolina	52.8	43.1	65.1	32.5	117.9	75.6

How To Meet Timber Needs

THE PROBLEM of meeting the timber requirements of South Carolina's forest industries boils down to this: certain classes of timber, chiefly the softwoods and the more valuable hardwoods, are being used faster than they are being replaced by growth. Essentially, the solution consists of closing the gap between anticipated timber needs and net growth.

Part of the solution is to increase the amount and improve the quality of the growing stock. This will necessitate better fire protection, more planting, thinning, taking special steps to encourage natural regeneration, and improving the species composition and quality of the stands. Yet these measures alone will not suffice to bring productivity up to the desired level if the deteriorating effects of current drain continue. Even if the best forest practices could be put into effect immediately, it would be many years before growth in many classes of timber could be brought in line with needs. In the meantime, heavy drain will continually thwart efforts to increase growth. Frequently, faster growth resulting from good cultural practices will be more than offset by reductions in total growth due to a dwindling volume of growing stock. Thus, closing the gap between growth and needs requires not only better timber cropping practices, but also important shifts in the commodity drain — shifts from timber in short supply to timber in better supply, and from localities which are receiving the brunt of the drain to areas where cutting is not quite so heavy. It also means stopping the destructive cutting that leaves the stand in poor condition for regeneration and growth.

Minimize Effects of Overcutting

It will not be possible to stop overcutting immediately and still provide the timber needed by the present forest industries, but many of its adverse effects can be diminished by making shifts in the drain by area, species, kind, and size of timber. If these and other suggested measures are put into effect, timber yields can be expected to equal anticipated timber needs.

Ease the Drain on Pole Timber in the Coastal Plain

The most urgent prerequisite to building up the growing stock is to ease the drain on pole timber in the Coastal Plain. Already in short supply, drain exceeded growth in 1946 by 517,000 cords. About half of this deficit was softwoods.

The large supply of pine pole timber in the Piedmont, along with the excess pole timber growth, offers an opportunity to shift some of the pole timber drain up-State. Each year for the next 20 years 100,000 cords of pulpwood drain could be transferred from the Coastal Plain to the Piedmont without jeopardizing attempts to build up the low supply of saw-timber growing stock. A large share of this should come from thinnings and improvement cuts in the overstocked young stands in this part of the State.

A greater use of pine topwood from trees cut for sawlogs would further relieve the pressure on the overcut pole timber. In 1946, the volume of pine trees cut for lumber in the Coastal Plain amounted to 1.1 million cords. The tops, most of which were left in the woods, amounted to 212,000 cords. About 5 percent of the 1946 pulpwood production came from tops of trees cut for lumber. Increasing this proportion to 15 percent would ease the drain on softwood pole timber by 67,000 cords. In view of the willingness of many producers to obtain pulpwood from tops, this goal seems reasonable. To achieve it would mean a closer working relationship between sawlog and pulpwood producers.

Material which could be obtained from thinning too dense stands will also help to ease overcutting of pine pole timber (fig. 60). Altogether there are 832,000 acres in pole and saw-timber stands of pure pine types that are more than adequately stocked. The greatest concentration of this acreage occurs in the group of counties located in the lower Piedmont. Here counties such as Abbeville, McCormick, Greenwood, Newberry, Fairfield, and York each contain over 25,000 acres of stands in need of thinning. In the Coastal Plain, Berkeley, Charleston, and Orangeburg Counties appear to offer the best opportunity.

FIGURE 60. — *A greater use of material from thinnings will help ease overcutting of pine pole timber in the Coastal Plain.*

Of course not all of the overstocked area is suitable for commercial thinning operations, as the excess trees are frequently too small or are hardwoods. Yet there are many stands which would yield 3 cords of pine thinnings per acre, enough to permit commercial pulpwood cutting operations. Intelligent thinning for pulpwood in these stands would utilize trees which otherwise would be eventually lost through mortality. This in turn would increase the growth on the remaining trees and hasten the building up of the depleted stock of saw timber. Thinning an additional 20,000 acres per year would reduce the pressure upon the Coastal Plain pine pole timber by at least 60,000 cords.

Ease the Drain on Saw Timber

In the Coastal Plain saw-timber growth for all species exceeded drain by 5.8 million board feet. Softwoods, however, were overcut by 73.7 million board feet. All the overcutting occurred in the southern Coastal Plain; in the northern Coastal Plain growth exceeded drain in all species groups. While soft hardwoods were overcut

in the southern Coastal Plain, the surplus growth in this species group in the northern Coastal Plain was more than sufficient to offset this deficit.

The excess growth in hard hardwoods of 75.5 million board feet offers an opportunity to transfer some of the softwood drain to these species. While oak lumber, for instance, is not a substitute for pine lumber, the development of a number of local markets for rough hardwood lumber would encourage small sawmill operators to cut oak instead of pine. Such markets might include plants making short length packaged lumber such as milpack.

Also, the adverse effects of heavy concentrations of drain in the southern Coastal Plain on the productivity of the stands could be reduced by transferring some of the softwood saw-timber drain to the northern Coastal Plain, where cutting is not nearly as heavy.

Yet as long as the demand for timber continues at the 1946 level, there is little chance of completely eliminating overcutting of softwood saw timber in the Coastal Plain. However, if enough shifts in the drain could be made to reduce overcutting to 50 million board feet a year, the damage to the growing stock would be greatly diminished. This would mean a reduction in growing stock volume of about 8 percent over the next 20 years. By that time, greater growth resulting from expected better forestry practices should more than offset overcutting.

In the Piedmont, overcutting of saw timber is far more serious. With saw-timber growing stock already 33 percent short of needs, 1946 drain exceeded growth by 68.9 million board feet. The softwoods were overcut by 66.6 million board feet, the soft hardwoods by 13.4 million, while the hard hardwoods increased.

The surplus of pole timber offers the greatest opportunity to ease the drain on saw timber. In 1946, of the 290.5 thousand cords of pine cut for pulpwood, 197.4 thousand cords were cut from saw timber. The excess growth in softwood pole timber amounted to 163 thousand cords. Another 134 thousand cords per year can be taken from the excess pine pole timber growing stock for the next 20 years without jeopardizing efforts to build up saw-timber growing stock. If no saw-timber trees were cut for pulpwood, pine saw-timber growth would exceed drain. A complete shift to pole timber may not be practical. However, cutting no trees above 11.0 inches for pulpwood would result in reducing the drain on saw timber by 53 million board feet, while at the same time meeting pulpwood drain.

Another saving in saw-timber volume could be accomplished by shifting the lumber drain to the larger diameters. Because a large part of the volume of small trees consists of tops, slabs, and sawdust, a cord of wood from 18-inch trees will yield about 45 percent more lumber than a cord from 10-inch trees. For instance, if the lumber cut from 9- and 10-inch trees in the Piedmont in 1946 had been cut from larger trees, the yield in lumber would have been greater by about 6.5 million board feet.

Use More Cull Hardwoods and Mill Waste for Fuel Wood

A shift in the kind of timber cut for fuel wood offers still another opportunity to ease overcutting. In 1946, 267 thousand cords of softwood pole timber and 103 thousand cords (39 million board feet) of softwood saw timber were cut for fuel wood in South Carolina. Total drain on the hardwood pole timber amounted to 609 thousand cords, 235 thousand cords more than growth. Eighty-seven percent of this drain went into fuel wood, most of it for tobacco curing. Cull hardwoods in the State amounted to 28,846 thousand cords. More of this kind of material could be used for fuel wood instead of the classes of timber already overcut and in short supply. Also, in 1946, nearly a million cords of slabs and edgings were produced in South Carolina and only about 7 percent of this volume was used for domestic fuel wood and tobacco curing. Here is an instance where the sawmill industry can help materially in building up its future supply of timber through industry-wide effort to market more slabs and edgings for fuel wood.

Guide Development of Forest Industries

A prerequisite to building up the growing stock and eventually bringing growth and drain in balance is the discouragement, temporarily at least, of any further expansion of forest industries which would compete with existing industries for timber in short supply. Any new industry which would increase the drain pressure on pine or the soft hardwoods should be discouraged.

However, there is room for new industries. In 1946, there was a surplus growth of oaks and other hard hardwoods of 86.6 million board feet. This would support, for instance, a number of plants to cut the clear pieces from rough hardwood lumber produced by

small portable mills. One possibility might be plants equipped with dry kilns and suitable machinery to manufacture packaged lots of short-lengthed clear lumber for sale to furniture plants. Flooring could also be produced. This would provide markets for hardwood lumber cut by small mills, and might divert some of the present pine-mill operators to cutting hardwoods.

Cull hardwoods in South Carolina amount to 28.8 million cords. The development of a commercial use for this material would go a long way toward improving the productivity of the present forest stands. There are many lines of research now under way that will expand the markets for these low-grade hardwoods. A promising use is the manufacture of molasses for cattle feeding. A number of plants producing molasses from wood in South Carolina would complement the developing cattle industry in the State.

There is also room for plants that could use manufacturing wastes such as shavings and sawdust. A survey in 1944 of eight counties around Columbia disclosed an annual production of 332,000 tons (oven-dry) of pine wood waste, including slabs, edgings, and sawdust from sawmills, and sawdust and shavings from concentration yards (fig. 61). About 188,000 tons of this was not used and would be available, for instance, to a plant manufacturing wallboard. A number of such plants are now being erected in the United States. More are being planned.

Many forest products are shipped out of the State as rough lumber. Further refinement or manufacture of this lumber into finished products would permit the establishment of new industries, such as furniture and millwork plants, without adding to the drain pressure on the timber resources.

Improve Timber-Growing Practices

Building up the growing stock will take more than adjusting the drain pattern and guiding forest industrial development. Easing the drain on timber overcut and in short supply may serve to arrest forest deterioration. But this alone will not improve the stocking and quality of forest stands. Additional measures are needed to build growing stock productivity up to the level required to sustain present and future drain on the forest.

Natural increases in young timber can be expected to eliminate some of these shortages in growing stock. In the Piedmont, where young timber is already in good supply, softwood saplings have increased by one-third since 1936. This increase is equivalent to 20,000 acres of adequately stocked land a year. The increase in hardwoods was even greater. Thus, regeneration in the

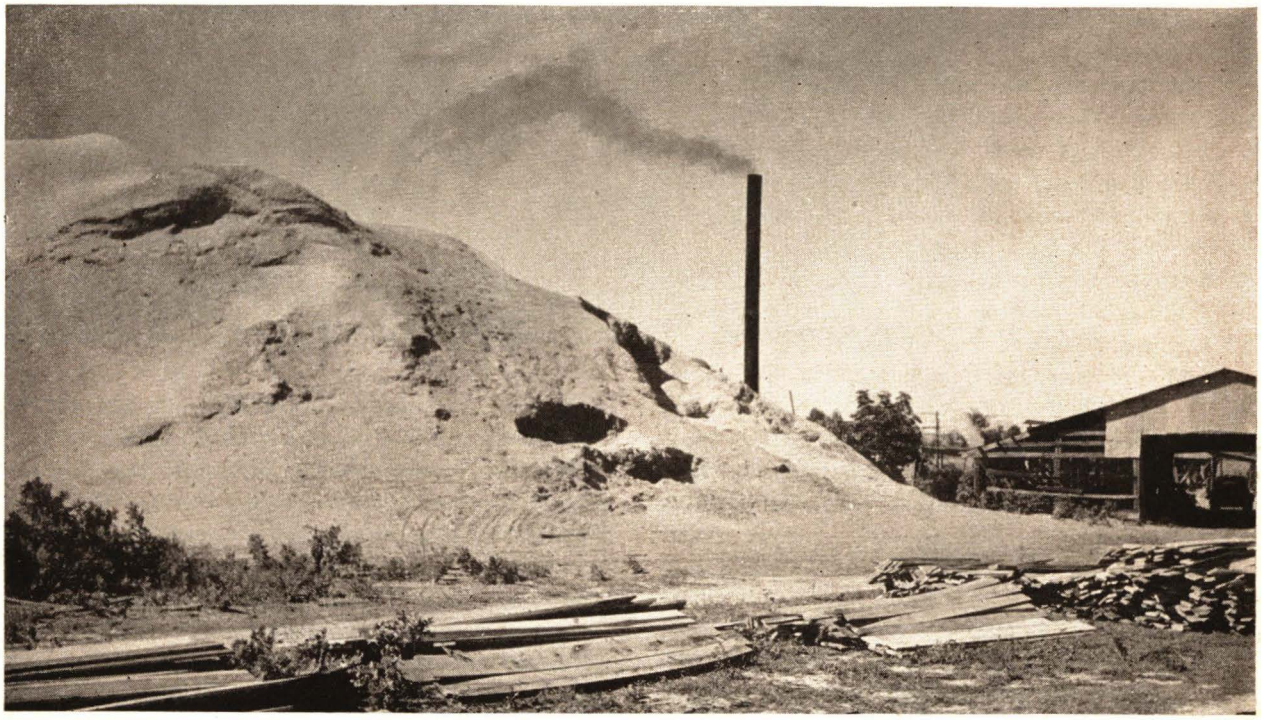

FIGURE 61. — *Three-year accumulation of sawdust and shavings at concentration yard at Blaney, S. C.*

Piedmont is largely satisfactory. Only in local areas are special measures needed to hasten restocking in order to arrest further erosion and improve the composition and quality of the new stands.

Deficiencies in the hardwood growing stock in the Coastal Plain will also be eliminated gradually by natural regeneration. The basal area of hardwood saplings is increasing at an annual rate of 3.2 percent a year. This increase, along with the already large backlog of young hardwoods, will be more than adequate to ultimately build up the hardwood growing stock. The problem here, as in the Piedmont, is one of improving the quality and composition of this young growth. With a growing shortage of high-quality hardwoods, the need for taking special measures to grow this kind of timber will increase.

However, natural regeneration, unaided by man, cannot be counted on to make up the deficiencies in the softwood growing stock in the Coastal Plain. The shortage of softwood is equivalent to 1,230,000 acres of adequately stocked land. The natural increase in stocking is equivalent to only 6,500 acres of adequately stocked land a year. This would amount to 130,000 acres in 20 years. Thus, the job of building up the depleted supply of softwoods involves restocking over a million acres with pine, either by taking special measures to encourage natural regeneration or by planting.

Natural regeneration may be increased in a number of ways. One way is to leave sufficient seed trees of the proper size, quality, and species on the land following logging to assure an adequate seed source. Another way is to reduce the damage to young timber from fire through increased protection. Fire protection is of basic importance in increasing natural reproduction and the volume of future growing stock in the State. While in some instances controlled fire can help to increase the regeneration of pine, uncontrolled burning destroys thousands of young pine seedlings each year.

Much progress has been made in recent years in the protection of timberlands in South Carolina. All of the 11.9 million acres of forest lands are now covered by organized fire protection compared to only 2.5 million acres in 1936. This added protection has not only reduced damage to trees of commercial size, but has also prevented the destruction of smaller saplings and seedlings which add substantially to the timber-growing stock in the State each year. There is still need for more intensive protection to minimize the current losses from fire.

A third way of getting forest land restocked with desirable trees is to eliminate the competition from undesirable trees and shrubs. The presence of hardwoods on the land presents one of the most serious obstacles to obtaining pine reproduction in the Coastal Plain. Many of the present pine stands are of old field origin on lands which formerly supported hardwoods. As these stands are cut, pine will be replaced by hardwoods unless special measures are taken to perpetuate the pine. Likewise, in the Sandhills, even with an adequate seed source, only the most drastic measures to eliminate competition from scrub oak will permit regeneration of pine (fig. 62). Here 312,000 acres of forest land under 40 percent stocked have an adequate seed source, but destruction of the scrub oak is necessary before these areas can restock and grow commercial timber.

In addition to working out practical methods of controlling hardwoods, ways for determining which sites are most suitable for growing pine or hardwood are needed. On some of the better hardwood sites it would not be advisable to attempt to perpetuate pine; on other sites, even with the added expense of controlling hardwood competition, growing pine will still yield the greatest returns to the landowner. The first step is to work out criteria for classifying sites according to their suitability for growing pine or hardwoods. The task is essentially one of correlating basic site characteristics such as soil, drainage, and successional trends with easily identified site indicators. Lesser vegetation, aspect, and topography may all provide important clues to the best use of the land.

The second step involves an expanded program of research to determine the species, size, and quality of timber that will result in the most effective use of forest land in each of the basic site classes recognized.

Improved timber-growing practices need to go beyond getting new stands established; the quality of the existing stands needs to be improved. This can be done both by modifying existing cutting practices and by adopting special cultural measures such as weeding and precommercial thinning. In young stands the pine is often being overtopped by vigorous hardwood sprouts. In more advanced stands, the pines are often already overtopped and suffering from hardwood competition. These hardwoods need to be removed. Frequently, the pine in the mixed pine-hardwood stand has been cut, leaving an overstory of poor-quality hardwoods. These should be cut if the pine in the understory is to survive. Also, much of the young pine in the Piedmont is growing in extremely dense stands. These should be

FIGURE 62. — *Mechanical destruction of scrub oak is one way to prepare the site for regeneration in the Sandhills.*

thinned if they are to produce saw timber in a reasonable length of time. Young hardwood stands generally need improvement as much as do the pine.

During recent years there has been considerable improvement in cutting practices on the part of many forest landowners, particularly pulp companies and other large industrial owners. In 1944 an estimated 42 percent of the forest lands in the State were under fair or better forest management. Since then the extent of such management has steadily increased. The number of technical foresters employed by private forestry firms has increased threefold. Improvements in cutting practices have included lighter or selection cuttings and thinnings in crowded stands. Also the use of such material as pine tops, formerly left in the woods as waste, is on the increase. Nevertheless, much additional improvement, particularly on small private holdings, will be necessary to achieve the growth goals for the State.

PLANT IDLE AND POORLY STOCKED FOREST LAND

Building up the pine growing stock will require more than special measures to increase natural regeneration. Such efforts will accomplish little more than to maintain the present proportion of pine in the State. The shortage can be made up by planting or possibly by direct seeding after suitable site preparation.

In the Coastal Plain there are large areas of nonforested idle land and poorly stocked forest land that can be planted. In 1947, 939,300 acres of idle land were not used for growing farm crops and had not yet begun to restock with trees. While much of this area is only temporarily out of cultivation and is best suited for farm crops, a substantial acreage is better suited to growing trees and should be planted as quickly as possible. This area, roughly 271,000 acres, is the land in capability classes V, VI, and VII as defined by the Soil Conservation Service (*8*) and includes 128,000 acres on the dry, infertile sands of the Sandhills counties and 143,000 acres in the remainder of the Coastal Plain.

In the Sandhills counties, 548,000 acres of forest land, under 40 precent stocked and without an adequate seed source, should also be planted. In the remainder of the Coastal Plain, 912,000 acres is under 10 percent stocked; about 45 percent of this area, or 410,000 acres,

is not expected to restock satisfactorily in the near future and should be planted.

In the Piedmont, it is estimated that 159,000 acres of idle land is better suited to growing timber than farm crops. Half of this is expected to restock naturally, leaving 79,000 acres to be planted. Another 395,000 acres of forest land is under 10 percent stocked. About 90 percent of this land can be expected to restock naturally in a relatively short time. However, in some localities, particularly in Union and the southern part of Spartanburg and Cherokee Counties, planting should supplement natural regeneration. Natural restocking is frequently delayed, resulting in continued deterioration of the site and in a sparse stand of limby, poor-quality timber. Other areas are restocking with less desirable species such as Virginia pine and upland sweetgum. Planting loblolly pine will assure prompt restocking as well as a more valuable crop. Thus, planting in the Piedmont should be limited to about 119,000 acres, 79,000 of idle land and 40,000 of poorly stocked forest land.

For the State as a whole, 1.3 million acres should be planted to pine in the next 20 years, distributed as follows:

	Idle nonforest land	*Forest land needing planting*	*Total*
	(acres)	*(acres)*	*(acres)*
Piedmont	79,000	40,000	119,000
Coastal Plain:			
Sandhills	128,000	548,000	676,000
Rest of Coastal Plain	143,000	411,000	554,000
Total	350,000	999,000	1,349,000

This would mean planting 67,000 acres annually requiring around 60 million pine seedlings (fig. 63). The cumulative total of successful plantations in South Carolina in 1949 was 133,894 acres. During the 3 years 1947-49, about 45 million seedlings (*10*) were planted in South Carolina, or roughly 50,000 acres. Thus only a very small part of the job has been accomplished. Estimated seedling production for the fiscal year 1950 is 32 million seedlings, enough to restock 36,000 acres. At this rate it would take nearly 40 years to complete the job.

FIGURE 63.—*The planting job in South Carolina requires doubling the present production of seedlings.*

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Appendix

Survey Methods

The forest survey of South Carolina utilized aerial photographs of the Production and Marketing Administration as a basis for preliminary estimates of forest area and timber stand-class area. A stratified sample of forest plots was located on the photographs and these plots were then carefully cruised on the ground. The county was the basic work unit. Detailed statistics by survey units and counties are given in Forest Survey Releases 25 and 28 (*12, 6*).

Area Estimates

Acreages of forest and other land were estimated with the use of a dot grid placed on every third contact print along each flight line in each county. The proportion of dots falling on forest land when applied to the gross area of the county, as reported in 1940 by the Bureau of the Census, yielded a preliminary estimate of the acreage of forest and other land-use classes in each county. This estimate was later revised after field checks of a sample of both forest and nonforest ground plots were made. All together 175,839 of these dots were classified.

Every fifth dot classified as forest in the preceding step was further classified into forest type, stand class, and density class by careful stereoscopic analysis of a one-acre plot surrounding the dot on the photograph. About 20,900 of these plots were classified. The proportion of plots falling in each classification when applied to the forest area of the county gave the total area in each classification. These areas were revised after a sample of plots was checked for proper classification on the ground.

In estimating the areas of various categories of land, there were two possible sources of error: (1) errors in classifying the dots and plots or in compiling the data, and (2) sampling errors. In this survey every effort was made to maintain a high order of accuracy in the collection and compilation. Frequent checks were made and a continuous program of training was carried out. The sampling intensity was sufficient to provide an estimate of the forest acreage of the State with a standard error of $\pm$ 0.7 percent. This indicates the probabilities are two out of three that the actual forest area is within $\pm$ 0.7 percent of the value given, provided measurement and computing errors have introduced no bias.

Volume Estimates

Timber cruisers made a detailed on-the-ground tally of a proportion of the photo plots in each stand class to obtain volume, growth, cull, and mortality data and to check the accuracy of the photo classification. Proportions varied according to the distribution of stand classes; in the Coastal Plain, for example, every 3d large saw-timber photo plot, every 8th small saw-timber, every 17th pole-timber, and every 30th seedling, sapling, and denuded plot was taken. The total amounted to 2,363 1/4-acre plots, although these were classified by forest type and stand class on a 1-acre basis. When the forest ground plots were taken, an additional sample of 569 plots, classified as agricultural on the photographs, was taken to provide a check on land-use changes since the date of photography.

In estimating timber volumes, the sources of error include (1) errors in classifying field plots and in compiling the data, (2) sampling errors, (3) inaccurate measurements of tree diameter, height, form, and cull, and (4) bias resulting from improper construction or use of tree volume tables. As in the case of area determinations, every effort was made to obtain accurate classifications, measurements, and final statistics through frequent checks and training. The volume tables used also were checked and were found to give reasonably accurate results. The standard error of estimate of the board-foot volume of saw timber in the State is $\pm$ 1.6 percent; a corresponding error for the total volume in cords was not computed, but it should be smaller.

Growth Estimates

Measurements for growth calculations were obtained from increment borings made in a mechanically selected

sample of plots. A total of 4,391 sample trees 3.0 inches and larger in diameter were bored. Radial growth rates of these trees were then compared with the radial growth rates of 22,311 sample trees obtained on the original survey. It was found that growth rates, for species of comparable size in similar stands, were the same; therefore, all 26,702 sample trees were used. In general, computational procedures consisted of adding the volume of small trees that grew to merchantable size or grew into a higher diameter class group during the period to the growth of the trees that remained in a particular diameter class. Sample tree diameters were increased by using the measured diameter growth of trees of the same diameter class. For instance, the average diameter growth of 8-inch trees was based upon the growth of trees which were 8 inches in diameter at the start of the growth period, not the last 10 years' growth of an 8-inch tree. Bark growth was allowed for. The differences between present and projected volume of the sample tree was then expressed as an annual percentage increase through the use of compound-interest tables and these percents were applied directly to the inventory volume. Mortality was obtained by special studies on the ground plots, and the total annual loss was deducted from total growth.

Drain Estimates

Estimates of commodity drain were made by obtaining the amount of wood produced as primary forest products from all the primary wood-using industries. Sawlog production was obtained from a 100-percent field canvass of the sawmills by the Bureau of the Census. Production of pulpwood, veneer logs, poles, piling, and other products was obtained by a field survey of the plants using these products. A special survey based upon area segments of the Master Sample of the Bureau of Agricultural Economics and the Bureau of the Census was used to obtain fuel-wood and fence-post production. All production figures were converted to drain in terms of inventory volume, using over- and under-utilization factors developed from a stratified sample of woods utilization practices. Drain estimates were prepared for each county. Detailed statistics by counties are given in Forest Survey Release 26 (*5*).

The principal sources of error in drain estimates, aside from mistakes in computing, are (1) reporting errors, (2) canvassing errors, and (3) sampling errors. Reporting errors stem from the failure of small manufacturers or wood producers to keep accurate records, and no measure of the extent of error introduced from this cause is available. Canvassing errors are failures to obtain reports from all the wood producers. These were held at a minimum through the use of trained enumerators and check surveys. Sampling errors are the only measurable errors involved. They ranged from $\pm$ 1.8 percent for sawlogs to $\pm$ 11.4 percent for fence posts. The sampling error for total cubic-foot drain in the State was $\pm$ 1.9 percent.

Public Landownership

Information on the forest area and timber volume in Federal, State, county, and municipal ownership was obtained in the following manner. The area under Federal jurisdiction was obtained from supervising agencies. The South Carolina State Commission of Forestry provided the figures for State forests and parks. County and municipal ownerships were obtained at each county courthouse from appropriate officials. The boundaries of all of these tracts, except the Sumter National Forest, were outlined on the aerial contact prints, and dot counts were made to determine the acreage of forest and nonforest land. Because of the scattered holdings in the Sumter National Forest, the boundary line drawn represented only a close approximation of the outside boundary. Dot counts made within this generalized area were then applied to the total area of the Forest. Forest plots were classified by forest type and stand class in each publicly owned area, thus giving the area by these classifications. Average volumes per acre by type and stand-size class, derived from survey unit summaries, were then applied to obtain volumes.

Definitions of Terms Used

Land Use Classes

Forest — Land bearing forest growth, land from which the forest has been removed and which shows no evidence of any other recent land use, or former agricultural land which now has a 5-percent stocking of trees. Subdivided into the following classes:

Commercial — Land bearing, or capable of bearing, timber of commercial character and available now or prospectively for commercial use.

Withdrawn — Forest land in public ownership upon which commercial timber cutting is prohibited.

Nonproductive — Forest land of such low productivity or so inaccessible that commercial timber will not be produced.

Nonforest — Land less than 5 percent stocked with trees and showing evidence of nonforest use:

Agriculture — Under cultivation or in pasture, including farmyards on active farms.

Idle — Land previously cultivated or pastured but now idle or abandoned. If reverting to forest, there must be less than 5-percent stocking of trees.

Marsh — Low, boggy, nonforested land usually supporting a heavy growth of grass.

Sand dunes and beach — Nonforested sand dunes or coastal beaches.

Water — Includes both the small ponds and lakes less than 40 acres in size, and streams, sloughs, and canals less than 10 chains in width classed as "land area" by the Bureau of the Census. Also includes the "inland water" listed by the Census. On coastal areas the water line is the mean high-tide mark; tidal flats are classed as water.

Urban and other — Includes towns, suburban areas being developed for residential or other urban purposes, school yards, cemeteries, industrial sites, roads, railroads, power lines, and other rights-of-way. Scattered areas of timber within exterior boundaries of cities or villages are also included.

Forest Types

LONGLEAF PINE — Stands in which coniferous species comprise at least 25 percent of the dominant and codominant trees, with longleaf pine predominating. Slash pine is included in this type.

LOBLOLLY PINE — Stands in which coniferous species comprise at least 25 percent of the dominant and codominant trees, with loblolly pine predominating. Spruce pine is included in this type.

SHORTLEAF PINE — Stands in which coniferous species comprise at least 25 percent of the dominant and codominant trees, with shortleaf pine predominating. Virginia pine and redcedar are included in this type.

POND PINE — Stands in which coniferous species comprise at least 25 percent of the dominant and codominant trees, with pond pine predominating.

CYPRESS — Stands in which cypress or cypress in mixture with tupelo comprise at least 25 percent of the dominant and codominant trees, with cypress predominating.

LOWLAND HARDWOODS — Stands in which mixed hardwoods such as tupelo gum, black gum, sweetgum, white oak, water oak, red maple, and ash comprise at least 75 percent of the dominant and codominant trees. Found along rivers, small streams, and on flat, poorly drained areas of the Coastal Plain.

UPLAND HARDWOODS — Stands in which mixed hardwoods such as southern red oak, scarlet oak, white oak, black oak, post oak, hickory, and yellow-poplar comprise at least 75 percent of the dominant and codominant trees. Found on mountain slopes, the rolling hills of the Piedmont, and occasionally on the drier sites in the Coastal Plain.

SCRUB OAK — Stands in which scrub species such as blackjack, bluejack, turkey, and laurel oaks predominate and in which sound commercial species comprise less than 5 percent of satisfactory stocking.

Stand-Size Classes

SAW TIMBER — Stands containing at least 1,500 board feet net, International 1/4-inch log rule, per acre in sound, live, softwood trees 9.0 inches d.b.h. or larger, or hardwood trees 11.0 inches d.b.h. or larger. Two classes of saw-timber stands are recognized:

Large saw timber — Stands of saw timber having more than 50 percent of the net board-foot volume in softwood trees 15.0 inches d.b.h. or larger, or hardwood trees 17.0 inches d.b.h. or larger.

Small saw timber — Stands of saw timber having 50 percent or less of the net board-foot volume in softwood trees 15.0 inches d.b.h. or larger, or hardwood trees 17.0 inches d.b.h. or larger.

POLE TIMBER — Stands at least 10 percent stocked with pole-size or larger timber, at least one-half in pole sizes, and which have less than 1,500 board feet net per acre of saw timber.

SEEDLING AND SAPLING — Stands less than 10 percent stocked with pole-size or larger trees and with less than 1,500 board feet net per acre, but at least 40 percent stocked with commercial species. Eight hundred seedlings or saplings per acre are considered full stocking.

POORLY STOCKED AND UNSTOCKED — Stands of pole-size or larger trees that are less than 10 percent stocked, seedling or sapling stands less than 40 percent stocked, or nonstocked forest land.

Diameters

D.B.H. (DIAMETER AT BREAST HEIGHT) — Stem diameter in inches, outside bark, measured at 4 1/2 feet above the ground.

DIAMETER CLASS — All trees were tallied by 2-inch diameter classes, each class including diameters 1.0 inch below and 0.9 inch above the stated midpoint; e.g., trees 7.0 to and including 8.9 inches are in the 8-inch class.

Tree Classification

SOUND SAW-TIMBER TREES — Softwood trees at least 9.0 inches d.b.h. and hardwood trees at least 11.0 inches d.b.h., with not less than one merchantable butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound saw timber.

SOUND POLE-TIMBER TREES — Straight-boled trees between 5.0 inches d.b.h. and saw-timber size.

SOUND SAPLINGS — Straight-boled trees between 1.0 and 4.9 inches d.b.h.

CULL TREES — Trees that fail to qualify as sound saw timber or pole timber because of poor form, excessive limbiness, rot, or other defect. Volumes shown for cull trees include also the limbs, in sections 4 feet long and at least 4.0 inches in diameter inside bark, of saw-timber-size hardwoods.

Species Groups

SOFTWOODS — All of the pines, eastern redcedar, pond cypress, baldcypress, and hemlock.

SOFT HARDWOODS — Black and water tupelos, sweetgum, soft maple, yellow-poplar. The other soft hardwoods include sweetbay, cottonwood, willow, and southern magnolia.

HARD HARDWOODS — All of the oaks, hickories, and ash. Volumes shown for sycamore and birch also include river birch, beech, elm, honeylocust, and sycamore.

Volume Estimates

BOARD-FOOT VOLUME — The volume in board feet, measured by the International 1/4-inch rule, exclusive of defect in that portion of saw-timber trees between the stump and the upper limit of merchantability for sawlogs.

VOLUME IN CORDS — For sound trees the volume in standard cords (including bark) of the sound portion of trees 5.0 inches d.b.h. and larger, between stump and a minimum top-stem diameter of 4.0 inches inside bark. For cull trees similar volumes are included plus the volume in limbs, in sections 4 feet long and at least 4.0 inches in diameter inside bark, of saw-timber-size hardwoods.

VOLUME IN CUBIC FEET — Same as volume shown in cords except bark is not included.

INTERNATIONAL 1/4-INCH LOG RULE — A rule for estimating the board-foot volume of 4-foot log sections, according to the formula $V = .905\ (0.22D^2 - 0.71D)$. The taper allowance for computing the volume in log lengths greater than 4 feet is 0.5 inch per 4-foot section. Allowance for saw kerf is 1/4 inch.

STANDARD CORD — A stacked pile, 4 by 4 by 8 feet, of round or split bolts, estimated to contain, on the average, 90 cubic feet of softwoods (wood and bark) or 80 cubic feet of hardwoods (wood and bark).

Growth and Drain

GROWING STOCK:

Saw timber — The sawlog volume of all sound saw-timber-size trees.

All timber — The cord or cubic-foot volume of the entire stem from stump to a minimum 4-inch diameter inside bark, of all sound trees 5.0 inches d.b.h. or larger. No limbs or cull trees included.

NET GROWTH:

Board foot — The change during the calendar year in the saw-timber growing stock resulting from tree growth and mortality losses. Includes the gains accruing from the growth of small trees into saw-timber sizes during the year.

Cord or cubic foot — The change during the calendar year in the stem volume of all sound trees 5.0 inches and larger resulting from tree growth and mortality losses. Includes the gains accruing from the growth of saplings into pole sizes during the year.

MORTALITY:

Board foot — The net volume lost from the saw-timber growing stock during the calendar year by the death of individual trees through the normal action of fire, tree competition, disease, insects, drought, and wind. Catastrophic losses did not occur during the growth period.

Cord or cubic foot — The net volume lost from the all-timber growing stock during the calendar year by the death of individual trees through natural causes.

COMMODITY DRAIN:

Board foot — The net volume removed from the saw-timber growing stock through cutting of timber products and logging waste during the calendar year.

Cord or cubic foot — The net volume removed from the all-timber growing stock through cutting of timber products and logging waste during the calendar year.

Lumber or trade name	Recognized common name	Botanical name
	SOFTWOODS	
Cedar, red	Eastern redcedar	*Juniperus virginiana*
Cedar, white	Atlantic white-cedar ("southern white cedar")	*Chamaecyparis thyoides*
Cypress	Baldcypress ("southern cypress")	*Taxodium distichum*
	Pondcypress	*T. ascendens*
Hemlock	Eastern hemlock	*Tsuga canadensis*
Pine, southern yellow	Loblolly pine	*Pinus taeda*
	Longleaf pine	*P. palustris*
	Pitch pine	*P. rigida*
	Pond pine	*P. rigida* var. *serotina*
	Shortleaf pine	*P. echinata*
	Slash pine	*P. caribaea*
	Virginia pine	*P. virginiana*
Pine, white	Eastern white pine	*P. strobus*
	HARDWOODS	
Ash, white	Carolina ash	*Fraxinus caroliniana*
	Pumpkin ash	*F. tomentosa*
	Red ash (and varieties)	*F. pennsylvanica*
	White ash	*F. americana*
Basswood	American basswood (related species)	*Tilia americana*
Beech	American beech	*Fagus grandifolia*
Birch	River birch	*Betula nigra*
	Sweet birch	*B. lenta*
	Yellow birch	*B. lutea*
Buckeye	Yellow buckeye	*Aesculus octandra*
Butternut	Butternut	*Juglans cinerea*
Cherry	Black cherry	*Prunus serotina*
Chestnut	American chestnut	*Castanea dentata*
Cottonwood	Eastern cottonwood	*Populus deltoides*
	Swamp cottonwood	*P. heterophylla*
Dogwood	Flowering dogwood	*Cornus florida*
Elm, soft	American elm	*Ulmus americana*
	Winged elm	*U. alata*
Gum, black	Black tupelo (blackgum)	*Nyssa sylvatica*
	Swamp tupelo (blackgum)	*N. sylvatica* var. *biflora*
Gum, red	Sweetgum	*Liquidambar styraciflua*
Hackberry	Hackberry	*Celtis occidentalis*
Hickory, bitternut	Bitternut hickory	*Carya cordiformis*
Hickory, Carolina	Carolina hickory	*C. carolinae-septentrionalis*
Hickory, mockernut	Mockernut hickory	*C. tomentosa (Hicoria alba)*
Hickory, pignut	Pignut hickory	*C. glabra*
Hickory, red	Red hickory	*C. ovalis*
Hickory, shagbark	Shagbark hickory	*C. ovata*
Holly	American holly	*Ilex opaca*
Honeylocust	Honeylocust	*Gleditsia triacanthos*
Locust	Black locust	*Robinia pseudoacacia*
Magnolia	Cucumbertree	*Magnolia acuminata*
	Southern magnolia	*M. grandiflora*
Maple, hard	Sugar maple	*Acer saccharum (A. saccharophorum)*
Maple, soft	Red maple	*A. rubrum*
	Silver maple	*A. saccharinum*
Oak, red	Black oak	*Quercus velutina*
	Cherrybark oak	*Q. falcata* var. *leucophylla*
	Northern red oak	*Q. borealis*
	Scarlet oak	*Q. coccinea*
	Southern red oak	*Q. falcata*
	Swamp red oak	*Q. falcata* var. *pagodaefolia*
	Water oak	*Q. nigra*
	Willow oak	*Q. phellos*
Oak, white	Chestnut oak	*Q. montana*
	Live oak	*Q. virginiana*
	Overcup oak	*Q. lyrata*
	Post oak	*Q. stellata*
	Swamp chestnut oak	*Q. prinus*
	White oak	*Q. alba*
Persimmon	Common persimmon	*Diospyros virginiana*
Sycamore	American sycamore	*Platanus occidentalis*
Tupelo (black gum)	Water tupelo	*Nyssa aquatica*
Walnut	Black walnut	*Juglans nigra*
Yellow-poplar	Yellow-poplar	*Liriodendron tulipifera*

SUPPLEMENTARY TABLES

The following tables present additional data in a form that will be found in all Forest Survey State or subregional reports so readers may combine or compare the data with similar data for several such areas.

TABLE 19. — *Commercial forest land area, by ownership and stand-size classes, South Carolina, 1947*

Ownership class	Total	Saw-timber stands	Pole-timber stands	Seedling & sapling stands	Nonstocked & other areas not elsewhere classified
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Federally owned or managed:					
National forest	516	250	181	69	16
Indian	3	1	2	(1)	(1)
Other	141	54	19	60	8
Total	660	305	202	129	24
State	172	49	32	84	7
County and municipal	22	14	5	3	(1)
Private	11,046	4,674	2,829	2,685	858
All ownerships	11,900	5,042	3,068	2,901	889

[1] Less than 500 acres.

TABLE 20. — *Volume of live saw timber and primary growing stock on commercial forest land, by stand-size class, South Carolina, 1947*

Stand-size class	Volume	
	Live saw timber	Primary growing stock [1]
	Million bd. ft.	*Million cu. ft.*
Saw-timber stands	25,696	6,715
Pole-timber stands	2,631	1,649
Seedling and sapling stands	1,022	377
Nonstocked and other areas not elsewhere classified	174	58
Total, all stands	29,523	8,799

[1] In this and following tables, primary growing stock is net volume, in cubic feet, of live saw-timber trees, and live pole-timber trees from stump to a minimum 4.0-inch top (of central stem) inside bark.

TABLE 21. — *Volume of live saw timber and primary growing stock on commercial forest land, by ownership class, South Carolina, 1947*

Ownership class	Volume	
	Live saw timber	Primary growing stock
	Million bd. ft.	*Million cu. ft.*
Federally owned or managed:		
National forest	1,378	465
Indian	5	2
Other	313	92
Total	1,696	559
State	292	95
County and municipal	53	21
Private:		
Farm	(1)	(1)
Industrial and other	(1)	(1)
Total	27,482	8,124
All ownerships	29,523	8,799

[1] Breakdown of volumes in private ownership not available.

TABLE 22. — *Volume of live saw timber and primary growing stock on commercial forest land, by species, South Carolina, 1947*

Species	Volume	
	Live saw timber	Primary growing stock
	Million bd. ft.	*Million cu. ft.*
Softwoods:		
Longleaf and slash pines	2,260	647
Shortleaf and loblolly pines	12,498	3,375
Other southern yellow pines	1,430	389
White and red pines	16	4
Hemlock	33	6
Cypress	1,292	360
Other eastern softwoods	31	25
Total softwoods	17,560	4,806
Hardwoods: [1]		
White oaks	696	298
Red oaks	1,930	582
Soft maples	689	274
Sweetgum	2,425	745
Tupelo and blackgum	3,397	1,127
Ash	417	148
Hickory	525	188
Yellow-poplar	1,208	303
Other eastern hardwoods [2]	676	328
Total hardwoods	11,963	3,993
Total, all species	29,523	8,799

[1] 10-inch hardwoods not included.

[2] Includes small volumes of sugar maple, sycamore, beech, birch, cottonwood, basswood, and black walnut.

TABLE 23. — *All-timber volume on commercial forest land, by kind of material, South Carolina, 1947*

Kind of material	Volume
	Million cubic feet
Live all timber:	
Primary growing stock	8,799
Secondary growing stock[1]	2,227
Total	11,026
Salvable dead all timber	0
Total, all timber	11,026

[1] In this and following tables, secondary growing stock is the net volume in cubic feet of all cull trees from stump to a minimum 4.0-inch top inside bark, and limbs to a 4.0-inch diameter inside bark of all cull and noncull hardwood trees.

TABLE 24. — *Net growth and normal mortality of live saw timber and primary growing stock on commercial forest land, by species group, South Carolina, 1946*

Species group	Live saw-timber volume		Primary growing stock	
	Current annual net growth	Current annual normal mortality	Current annual net growth	Current annual normal mortality
	Million board feet	*Million board feet*	*Million cubic feet*	*Million cubic feet*
Softwoods	930	94	268	26
Hardwoods	527	23	150	8
Total	1,457	117	418	34

TABLE 25. — *Commodity drain of live saw-timber volume and primary growing stock on commercial forest land, by species group, South Carolina, 1946*

Species group	Live saw-timber volume			Primary growing stock		
	Cutting drain	Logging waste	Commodity drain[1]	Cutting drain	Logging waste	Commodity drain[1]
	Million board feet	*Million board feet*	*Million board feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Softwoods	1,035	36	1,071	233	24	257
Hardwoods	416	33	449	119	22	141
Total	1,451	69	1,520	352	46	398

[1] Total of cutting drain and logging waste.

TABLE 26. — *Commodity production in cubic volume and in standard units, by timber product, South Carolina, 1946*

Product	Cubic volume	Standard unit	
	M cubic feet		*Number*
Sawlogs (for lumber, timber, and sawn ties)	170,749	M board feet[1]	1,008,100
Veneer logs and bolts	23,219	do.	139,100
Cooperage logs and bolts	607	do.	3,500
Pulpwood bolts	80,147	Standard cords[2]	1,022,000
Fuel wood	134,990	do.	1,839,100
Piling	596	Linear feet	840,000
Poles	3,999	Pieces	310,000
Posts (round and split)	3,599	do.	5,410,000
Hewn ties	970	do.	294,000
Round mine timbers	267	do.	70,400
Miscellaneous	4,555	Cubic feet	4,555,000
Total, all products	423,698	.....	.....

[1] Board feet, International ¼-inch rule.

[2] Standard cords—round wood (unpeeled). A pile of stacked wood 4 by 4 by 8 feet within its outside surface.

TABLE 27. — *Live all-timber volume on commercial forest land, by kind of growing stock, species group, tree-size class, and class of material, South Carolina, 1947*

Kind of growing stock, tree-size class, and class of material	Total	Softwoods	Hardwoods
	Million cubic ft.	*Million cubic ft.*	*Million cubic ft.*
Primary growing stock:			
Live saw-timber trees:			
Sawlog portion	4,865	2,852	2,013
Top portion	1,114	663	451
Total	5,979	3,515	2,464
Live pole-timber trees	2,820	1,291	1,529
Total primary growing stock	8,799	4,806	3,993
Secondary growing stock:			
Sound cull trees:			
Saw-timber size	489	137	352
Pole-timber size	407	44	363
Total	896	181	715
Rotten cull trees	988	46	942
Limbs	343	0	343
Total secondary growing stock	2,227	227	2,000
Grand total	11,026	5,033	5,993

TABLE 28. — *Volume of live saw timber on commercial forest land, by diameter class group and species, South Carolina, 1947*

Species	Diameter class group		
	9.0—12.9 inches d.b.h.[1]	13.0—18.9 inches d.b.h.	19.0 inches d.b.h. and larger
	Million bd. ft.	*Million bd. ft.*	*Million bd. ft.*
Longleaf and slash pines	1,207	894	159
Shortleaf and loblolly pines	4,703	5,392	2,403
White and chestnut oaks	146	358	192
Tupelo and blackgum	813	1,990	595
Sweetgum	439	1,276	710
Yellow-poplar	170	679	359

[1] 10-inch diameter class not included for eastern hardwoods.

TABLE 29. — *Net growth, normal mortality, and commodity drain on primary growing stock on commercial forest land, by tree-size class, South Carolina, 1946*

Tree-size class	Current annual net growth	Current annual normal mortality	Current annual commodity drain
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*
Saw-timber trees	361	22	301
Pole-timber trees	57	12	97
Total, all trees	418	34	398

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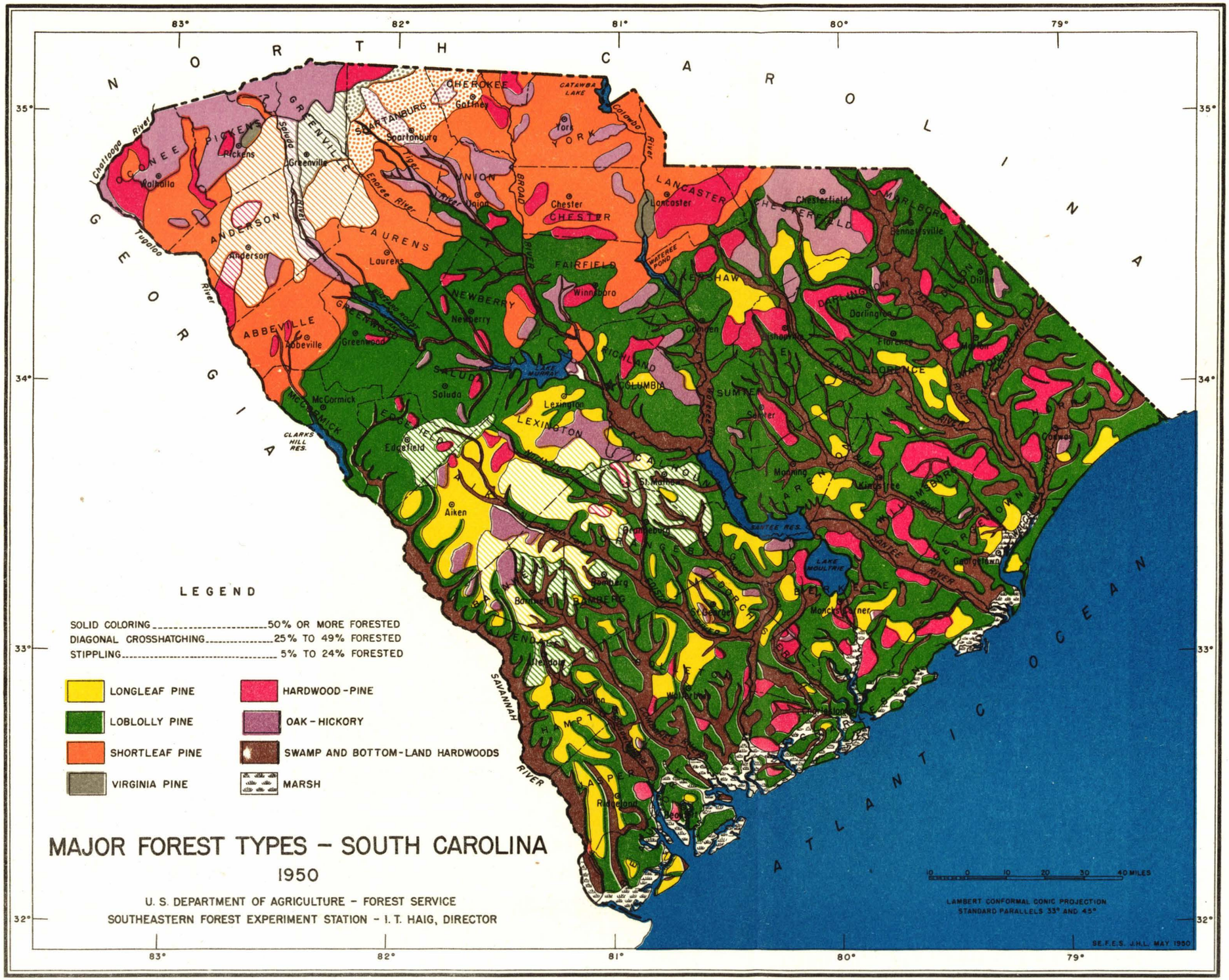

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